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NORTHEASTERN FOREST EXPERIMENT STATION

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PROBLEMS AND PROGRAM
of the
NORTHEASTERN FOREST EXPERIMENT STATION
(Annual Report of the Director for 1938)

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PROBLEMS AND PROGRAM
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THE REGION

Forestry is at a Relatively Advanced Stage in the Northeast

The territory served by the Northeastern Forest Experiment Station, comprising all of New England and New York, is one of peculiar interest and significance with respect to forestry. In spite of more than two hundred years of intensive exploitation, the forests of the Northeast continue to make an important contribution to the economic life of the region. Having been subjected to the pressure of the country's greatest population density since colonial times--a pressure first expressed in the need for more cleared land for agriculture, then in successive waves of industrial utilization all too frequently accompanied by destructive fires, and more recently in the spread of suburban residential developments--the forests still occupy more than half of the land area. They are receiving more and more attention in recognition of their functions in ministering to the needs of the people for outdoor recreation, in providing cover and food for wildlife, in the protection of municipal water supplies, in minimizing floods, and in building soil, as well as in providing raw material for industry and fuel and cash income to farmers. Agencies concerned with planning for the use of land and for social and economic development are realizing more and more the importance of the forest resource and the extent to which the region must look to the forests and industries dependent upon the forest for support of the rural population. The hurricane of 1938, playing havoc with the timber in a zone one hundred miles in width from Long Island Sound to the Canadian border, has focused public attention on forest problems as never before.

The effects of the long cycle of forest exploitation in the Northeast may serve as an object lesson to guide developments in the newer sections. At the same time in many ways this region points the way for other sections of the country in both state and private forestry activity. Because of its dense population and relatively long economic history, public appreciation of forestry is perhaps further developed in this region than in any other.

Decades of widespread public education in forestry have developed an informed public opinion which calls for a departure from the generalities formerly sufficing and demands solution of the many specific problems encountered in actual forestry practice. The problem here is not one of retaining land in forest, but of how to make forest land productive and how to correlate recreation, wildlife, timber production, and watershed protection. Rather than argue that the forest is a crop, the demand is increasingly for information on how the crop should be handled. With fire protection generally established and increasing in effectiveness, the need is now for better protection from insects and disease. Furthermore, the water problem in this region is beginning to be recognized not so much as one of reforestation as of the character of the forest cover, which in turn is intimately related to the intensity of forest management.

All in all, the Northeast is past the stage where elementary, superficial, technical information will meet the need. Only by thoroughgoing research dealing with economic as well as technical aspects of the problems in hand can real progress be made.

Another noteworthy aspect of the situation here is that the forty million acres of forest land, all within a few hundred miles of the large centers of industrial development, present such a wide range of conditions, both natural and economic. On the one hand, there are over eleven million acres of farm woodlands while, on the other, an almost unbroken wilderness of about ten million acres still remains in northern Maine. Economically, the region may be considered in three zones which are rather closely related to, although not coextensive with, the four major forest types of the region.

The Sparsely-settled Wild Lands

The sparsely-settled wild lands of northern New England and New York present an entirely different set of problems than does the rest of the region. This zone corresponds roughly to the spruce-northern hardwoods type. It contains the bulk of the merchantable timber supply in the Northeast, but must compete with water shipments from the South, the Pacific Northwest, Nova Scotia, and Newfoundland in the consuming markets of the industrial and urban centers along the coast.

Although white pine was originally a very important element, the forests of this zone are now composed primarily of yellow and paper birch, beech, and sugar maple, intermingled with red spruce and balsam fir. In recent years the production of softwood lumber has given way almost entirely to the cutting of pulpwood. Because of lack of transportation facilities, hardwoods have had practically no market throughout much of the region, especially in Maine. However, in Vermont and portions of Maine, New Hampshire, and New York, where the original growth of spruce has been largely exhausted and where roads have been developed, a number of hardwood industries assume major importance.

Ownership of the land in this northern forest zone differs from conditions elsewhere in the Northeast in that relatively large areas are controlled by a few paper companies or estates, individual holdings frequently running into hundreds of thousands of acres and in one case as high as two million acres. In this zone are also found the major units of public ownership in the Northeast; namely, the White and Green Mountain National Forests and the Adirondack Forest Preserve in New York. Forestry in this region will be largely of an extensive character and will be concerned with problems of industrial management and public ownership.

The Densely Populated Industrial Zone

At the other extreme is a zone immediately adjacent to the industrial and residential centers comprising most of Massachusetts east of the Connecticut River, all of Connecticut and Rhode Island, and the southeastern portion of New York. This zone corresponds roughly with the limits of the oak type in this region. Chestnut was formerly the most widespread and commercially valuable tree in this zone, but since its elimination by the blight the several species of oak have assumed a larger importance. Hemlock is the most important conifer in most of the zone, but northern white pine is abundant in much of Massachusetts.

The rapid development of agriculture in this zone led to early and very extensive clearing of land prior to the opening up of the West. Subsequent economic changes resulted in widespread abandonment of the poorer and rougher lands during the past century, and extensive areas have reverted to forest growth which, however, has frequently not been of desirable character. Furthermore, because of extreme accessibility the forests have been repeatedly combed for merchantable timber, clear-cutting by portable mills and stripping for fuelwood becoming the general practice in recent decades. Finally, this zone is subject to a period of severe fire hazard each spring, and prior to the development of systematic protection in recent years little of the area escaped some damage from fire. Even now repeated fires are responsible for the scrubby character of the forest growth in many sections, especially in Rhode Island and southeastern Massachusetts. The hurricane of 1938 came as a climax to the vicissitudes of the past in reducing the growing stock, or stand of usable timber, to the vanishing point throughout a large part of this zone. Although more than half the land area must still be classed as "forest", there is scant basis for much industrial development from this source.

However, with the ever increasing use of automobiles and the improvement of highways and country roads there has been a steady spread of suburban residential development and increasing migration of city people to the country. Proximity to urban centers or prospects of sale to city people for summer residence has raised land values in much of this zone to a relatively high level, thus creating a paradoxical situation in which the land is stripped and left non-productive because it is worth too much for timber production. Correlative to the increasing mobility of the city population is rapid extension of the size and number of parks, parkways, and other recreational areas. Another factor of importance in this zone is the need to provide water for the urban centers. Competition between communities for available supplies presents complex questions of land use planning. Protection of municipal watersheds offers perhaps the best opportunity for forestry practice in this zone.

The Farm Woodland Areas

The third zone, which may be described as intermediate between the other two both geographically and economically, corresponds roughly to the white pine and Allegheny hardwood types. Forests characterized by the predominance of white pine occur from southwestern Maine, through southern New Hampshire, much of central and eastern Massachusetts (which has been included in the densely populated, industrial zone), to the Connecticut River valley along which it extends well up into the northern forest. The Champlain basin and the plains of the lower Mohawk and upper Hudson are also designated as part of the white pine type. On the lighter soils of this type white pine has succeeded in reproducing itself through successive waves of exploitation. On the heavier soils there is a tendency for pine to alternate with hardwoods, among which oak and red maple are the most abundant. In the northern sections, however, yellow birch, beech, and sugar maple are the important elements in mixture.

The history of the white pine type has been very similar to that of the oak type. Extensively cleared for cultivation in early years, later allowed to revert to forest and subjected to repeated cutting, the growth now is generally of small size and inferior quality. However, the prevalence of pure stands of second growth pine on old fields and the ready market for such low grade products as box boards have served to maintain a substantial lumber industry right up to the present. The very heavy loss of white pine timber in the hurricane zone will sharply accentuate a dwindling of activity in the forest industries in the years immediately ahead, which was presaged by failure of white pine reproduction following widespread clear-cutting of old-field stands during recent decades.

The Allegheny hardwood types, which in this region may be considered along with the white pine type, occupies that part of New York State lying between the Pennsylvania line on the south and the Ontario plains and the Mohawk valley on the north. White pine was originally very generally distributed, but is now of only minor importance. Hemlock still supplies about half of the annual lumber cut, although this species has also been rather extensively exploited. Sugar maple and beech are the most common and important species. Basswood, black cherry, white ash, and red oak also occur in mixture and generally command excellent prices.

The history of this type is not as long as in the case of the white pine and oak types, but it has followed similar lines. Although scarcely settled at all prior to the opening of the nineteenth century, it is surprising to find that the peak of population in much of this section was reached around 1830. Abandonment of sub-marginal agricultural land, largely completed in New England, is still an important factor in land use adjustment here. In this the State is taking an active part through its huge reforestation program. Because the process of repeated cutting of the woodlands has not progressed so far in this type as in central and southern New England, forest growing stock is in much more satisfactory condition and woodland owners have better opportunity to organize for sustained yield management.

The zone consisting of the white pine and Allegheny hardwood types together is characterized by a well distributed rural population, numerous small cities, and a variety of wood-using industries. The zone is well served by a network of improved highways and town roads, as well as by numerous railroad lines. It supports a substantial and permanent agriculture primarily dependent upon dairying. Ownership is largely broken up among small holdings, and the woodland is generally intermingled with areas of pasture and cultivation. In the Allegheny hardwood type woodland constitutes only about 25 percent of the land area, but in the white pine section of New England the forest occupies considerably more than half the total area. This zone may perhaps be best described as the farm woodland area of the Northeast. From an economic point of view it is benefiting to a considerable extent, especially in New England, from the increasingly large number of city people who are buying up old farms for summer residences.

The contrast in forest conditions between the northern and southern sections of the region is further brought out by consideration of the stage of development of the forest growth. Only one-fifth of the forest area in the densely-settled industrial zone and one-fourth of the farm woodland areas support timber of sawtimber size, whereas in the sparsely-settled wild lands to the north more than two-thirds of the area is so classified. On the other hand, from 40 to 50 percent of the two southern zones supports nothing more than reproduction or brush, but less than one-fifth of the wild land zone is currently in this condition.

MAJOR PROBLEMS FOR RESEARCH

Feasibility and Place of Selective Cutting and Integrated Utilization in Restoring and Improving Forest Growing Stocks

The most fundamental forest problem throughout the Northeast is to restore and improve forest growing stocks so as to provide a sound basis for profitable sustained yield management and at the same time conserve watershed, wildlife, and aesthetic values. The problem exists even in the wild land zone because much of the area classified as sawtimber in the spruce-northern hardwood types is understocked and because so much of the timber present consists of poorly formed or defective residual trees in repeatedly-culled old growth forests. Furthermore, because of lower accessibility, the timber in this northern zone must be of larger size and better quality to be commercially attractive.

Timber of large size and high quality has always been in demand at good prices; in fact, in the early days only the very best timber could be sold. The use of wood for charcoal and distillation products is the only significant exception to this. The growing demand for chestnut and oak for railroad ties in the decades following the Civil War lowered earlier standards of profitable utilization for these hardwoods. Similarly, heavy demands for box boards to provide shipping containers for New England's many industrial products, which reached a peak early in the present century, made possible the wholesale utilization of the inferior second growth white pine; and the rise of the pulp and paper industry paved the way for extensive clear-cutting in the northern spruce types. Each new form of utilization and each technological advance inthe manufacture of forest products, applied without regard for conservation of growing stock or permanence of

raw material supply, has carried forest depletion to a more advanced stage, provided only transient prosperity, caused some loss in earlier industry, and raised more critical problems of sustaining the industries which remain.

The welfare of the forest industries is very directly dependent upon proper management of the forests and particularly upon the maintenance of a growing stock containing a substantial proportion of high quality timber of relatively large size. No matter how much land there may be in forest or how great the annual growth of wood material may be, it can not have an economic value unless it can be realized in trees of merchantable size; and growth on stems of size suitable for the manufacture of high quality products is far more valuable than the same amount of growth dissipated on saplings and brush which can never be utilized.

The oft cited theory that with new methods of chemical utilization the harvesting of forest crops on very short rotations will supplant traditional sawtimber production is largely a will-o'-the-wisp. It has been repeatedly shown that costs of handling forest material mount very rapidly as the average size of the stems decreases. Furthermore, the converting industries have never been able to pay a price for their raw material comparable to that commanded by high quality sawtimber. There is no indication that this situation will change. On the contrary, there is abundant support for the belief that the interest of public and landowner alike will be best served by a forest management program based on an integration of use, in which high quality sawlogs are the primary objective while pulpwood, small dimension stock, and other forms of utilization take that part of the forest crop which does not meet the requirements of the more exacting products. Such integrated utilization would be most conducive to sustained yield and could be accomplished through a succession of partial cuttings repeated at frequent intervals rather than by clear-cutting which offers no prospect of further income from the land for a century.

To provide an economic and technical foundation for such selective cutting and for the building up of forest growing stock is the broad objective of much silvicultural, economic, and forest products research in this region. The objective may be attained by developing appropriate forest practices, determining the best basis for organizing timber harvesting operations for sustained yield, and studying methods of improving the channels of trade through which forest products reach the consumer.

Utilization of Surplus of Small and Low Grade Material: A Major Problem in the Densely Settled Industrial Zone

Because depletion of forest growing stock has already advanced so far in much of the northeastern territory, a program of sustained industrial activity such as has been outlined above hinges to a large extent upon the development of outlets for the huge quantities of small and low grade material which will have to be taken from present stands in the process of forest restoration. It is believed that in the Northeast there is currently a substantial excess of annual growth over commercial use. Although the accumulation of current surpluses of growth over cut is the only way in which forest growing stocks can be built up, a large part of the current surplus is not in trees of species, size, or character in demand by

the lumber and other primary wood-using industries. The surplus includes much by-product material in the form of residual trees in cull-old growth stands, trees which should be removed in thinning or improvement of second growth stands, and material of inferior species or form coming in on abandoned farms, burns, or areas recently clear-cut. Such material needs to be removed currently if forest values are to be restored. Without profitable outlets for such material there is little hope of checking the cumulative deterioration of forests in the industrial and farm woodland zones or of maintaining the limited industrial activity which they still support.

Wider use of hardwoods for pulp, commercial development of new plastic made from wood, fermentation of cellulose to produce ethyl alcohol and other chemical products, broadening the market for charcoal to permit expansion of the wood distillation industry and the use of wood gas for internal combustion engines, or for fuel in rural communities and certain industrial processes such as the annealing of brass and the baking of brick, are some of the possibilities to be explored. Stimulation of a return to the use of wood for fuel, especially in rural communities, is perhaps as important as any new uses which may be developed. This involves modification in methods of handling fuel wood to reduce its cost to the consumer and improvement in equipment for burning to increase its efficiency and convenience in use.

The problem of utilization of small and low grade material is of particular importance in the densely settled industrial zone and in the farm woodland sections, especially those in New England. The inadequacy of present outlets has been forcibly emphasized during the past year by the difficulty of salvaging economically more than a small fraction of the timber windthrown by the September hurricane.

Improvement of Logging Methods, Equipment, and Organization: A Problem of Industrial Forestry in the Sparsely-settled Wild Lands

For the sparsely-settled wild lands of the spruce and northern hardwood forest, selective cutting and sustained yield management are intimately related to the development of roads for truck transportation and the improvement of operating practices. Organization of forest enterprises in this region has remained remarkably static for generations. The only major changes have been those associated with the transition from cutting of long logs for lumber to 4-foot wood for pulp. If sawlogs again become the primary objective of management, as we believe they should, and if integrated utilization gains any acceptance in the zone, practices adapted to the exclusive handling of 4-foot wood will have to be drastically revised.

Hauling over ice roads on sleds in winter and driving of the streams have been the only methods of logging in much of the region. Besides involving considerable uncertainty as to the costs of operation each year and requiring working under abnormal pressure when seasonal conditions are right, this system restricts the species which can be taken out to those which float, and involves difficult problems in providing food and supplies for men and animals on the operations. The relative inaccessibility of camps under this system makes effective supervision from headquarters very difficult and discourages the use of new ideas in equipment and method.

The effects of this system extend far beyond the logging operation itself. It involves important social problems in respect to woods labor, tending to perpetuate a transient, homeless element, and discouraging permanent community life. It encourages clear-cutting of all merchantable timber and limits the opportunity for intensive forest management. It makes protection from fire, insects, and disease difficult, and often renders hopeless the salvage of killed timber.

This situation makes it increasingly difficult for forest owners and operators in this region to produce timber in competition with that from more distant regions or from other countries, and tends to jeopardize the existence of important industries and reduce opportunities for gainful employment.

Effective planning of timber-harvesting operations would be greatly facilitated by studies of such matters as the proper balance between road construction to keep grades down and increased costs involved in hauling over excessive grade, effective skidding distance under varying conditions of slope and size of timber, the possibilities in the use of portable chutes and power saws for pulpwood, and of tractors for skidding and hauling. Zoning of the forests in terms of economic accessibility, determining the intensity of management applicable in each zone, planning transportation systems, and adapting operating methods to selective cutting are other difficult problems facing timberland owners interested in sustained yield management in the wild lands of the North.

Organization of Production to Improve the Channel of Trade from Stump to Market: An Answer to the Farm Woodland Problem

In the farm woodland areas because the timber is so generally accessible, occurring in relatively small tracts, interspersed with open land and well served with permanent roads, operating problems do not assume the importance they have in the sparsely-settled wild lands. On the other hand, utilization is only one phase of the problem, perhaps secondary in importance as compared to the densely settled industrial zone because, although generally badly run-down, northeastern farm woodlands do contain some material of size and quality to meet a wide variety of exacting demands, and they are capable of producing much more material of much better quality. For the farm woodlands marketing difficulties present the most serious problem. The small owners are unable individually to look up possible outlets for their forest products other than those which present themselves locally. The result is that farm woodlands are frequently cut for fuelwood or sold to the portable mill operator who rarely is able to pay full value for the timber and generally converts the entire stand into a single product with little effort to utilize waste. The tendency is to cut clear as soon as the timber reaches a size where some material is marketable, and in many cases this means converting into fuel wood or low grade construction lumber young, thrifty trees of valuable species just reaching a size where most rapid growth of high quality material is being put on. In other cases, the owner has opportunity to sell to specialized consuming industries, but these generally afford him an outlet for only the higher grade material which constitutes but a small proportion of what he has to

sell and leaves his lot in possession of the less valuable species and and least desirable trees which often may not be profitably operated alone.

In the farm woodland areas, cooperative organization holds much promise of creating conditions conducive to stable industrial development and sound forest management. Through cooperative organization the relatively small quantities of timber cut each year from individual farms under the principle of light selective cutting at frequent intervals can be accumulated into a sufficient volume to justify sorting and grading to effectively enter the markets for the diversified products which must be sold.

But in most situations the advantages of cooperative organization will not be fully realized unless the producers control their own processing facilities. The present unsatisfactory situation with regard to farm woodlands is attributed in large measure to the lack of adequate facilities for processing the material to meet competition from other regions. Only through control of the primary manufacturing facilities can industrial production in any locality be geared to the needs of the woodland owners. This is an element in the economic picture which has not been operating in the past. Industry has been primarily concerned with obtaining maximum profit from the manufacturing process and has been unmindful of whether or not an adequate return was provided for the timber grower. Substantial improvement in existing channels of trade may be expected through a program of cooperative forest management and utilization including all operations from forestry practice to marketing of processed material to lumber dealers, fabricating plants, or other consuming industries.

Economic Adjustment of Rural Communities Affected by the 1938 Hurricane

Many rural communities in New England have been becoming increasingly dependent upon the forests and forest industries during recent years. The decline in agriculture and loss of numerous enterprises in the textile industry have left some sections with little except the forests to provide employment and to sustain assessed valuations. The impact of this Agricultural and industrial transition has been offset, at least in part, by the development of recreational activity, but the forests still constitute the major resource.

Although timber values have probably not been fully recognized in local tax assessment rolls and although such values in the towns with larger population constitute only a small fraction of the tax base, it is likely that in some of the rural towns most seriously affected by the hurricane, the reduction of values in standing timber will present serious problems in readjustment of local taxation and in the maintenance of such public services as schools, roads, and local relief. Indeed the question of whether certain towns should continue to be maintained as independent units will come forward with increasing force, since the aftermath of the hurricane will extend far beyond the immediate question of timber taxation. Recreational values will in many instances be adversely affected by such widespread destruction of standing timber as resulted from the hurricane. Urban people who have maintained summer

homes in the hurricane zone may no longer find their surroundings attractive and may place their properties on the market for sale. Such changing of hands is bound to be accompanied by depreciation in all of the values involved. Other properties are likely to become tax delinquent and thus direct renewed attention to programs for public acquisition.

Increased activity in lumbering operations for the next couple of years resulting from salvage of windthrown timber will be followed by a period of greatly restricted activity. Industrial equipment may become idle and unemployment may be significantly increased locally. Such a development may well prove calamitous to rural communities which will have already lost a substantial part of their assessed valuations.

After the salvage activity subsides there is bound to be an increasing pressure for liquidation upon residual standing timber of merchantable size, in order to keep established mills in operation and to provide continued employment for those who have been depending upon woods work for a living. Thus the situation calls for the most effective forestry, utilization, and marketing practices so as to prevent further depletion, husband the young timber, rebuild the residual growing stock as rapidly as possible, and at the same time conserve the economic assets of the communities.

Thorough-going investigation of the many phases of this complicated problem should prove of value in guiding the States, the local communities, the business men, and the landowners involved through what bids fair to be a trying period of readjustment.

Other Aspects of Forestry in the Economic Life of the Region

Progress toward the major objective of sustained yield management through any of the channels suggested above is handicapped by lack of basic knowledge of the status of the forest resources and prospective demand for forest products, and by uncertainty with respect to the reaction of numerous economic factors upon any long-range forestry enterprise. A Forest Survey for the country as a whole has been in progress in the Pacific Northwest, the Lake States, and the South since 1930. Extension of this survey to the Northeast would determine for each state, and for smaller economic units, the quantity, quality, and location of existing supplies, the present and potential growth, the rate of depletion and consumption, and the trend in the utilization of forest products. Such information is essential for determining sustained yield capacities, and when correlated with results of the Forest Survey in other sections of the country, permits proper evaluation of the place of forestry in the economic life of the region. It is the key to intelligent long-range planning aimed at industrial and community stability.

Analysis of the present and potential place of woodlands in rural economy would be of especial advantage in stimulating better management of farm woodlands. Forestry is now generally recognized as an integral part of the farm business in the Northeast. But there is little information on the contribution which the woodlands are now making, of the opportunities for their more effective management, or of the indirect social benefits which may be derived from them. By stabilizing the opportunity for employment, building up the productive capacity of neglected stands, and providing supplementary cash income, forestry may fundamentally affect the margin of

profit in agriculture, the stability of population, the revenue from local taxation, the maintenance of roads and schools, and almost every other aspect of rural life.

Inequitable taxation is commonly held as a major handicap to sustained yield forest management. In some sections annual taxation of forests at essentially full market value places strong pressure on woodland owners to cut their timber as soon as it reaches salable size. Although the solution of the forest taxation problem must be worked out as an integral part of the whole scheme of taxation in a way which will bring relief to all forms of rural property, the present difficulty may be minimized and the burden rendered less onerous to the extent that selective cutting can be put into effect and adequate growing stocks maintained to produce regular income to meet the annual charges.

The risk of loss from fire, insects, and disease, as well as the difficulty in obtaining credit to finance forestry operations, offers other handicaps in the current situation. Inauguration of commercial forest fire insurance, a sound basis for which was indicated by Forest Service studies in this region prior to the hurricane, would eliminate one of these sources of uncertainty.

While a federal agency to finance forestry operations would be of inestimable value, the handicap which forest properties now face in the field of commercial credit might be largely eliminated if there were general recognition of the sustained yield principle and if ready markets for forest property could be developed. Salability is an important consideration in property pledged as collateral for a bank loan. Without public appreciation of the investment value of properly managed forest property, salability is lacking.

It will be seen that all these factors are interrelated so that progress can best be made by attack on a broad front. Improvement of forest practices and building up of growing stock will facilitate solution of the underlying economic problems, and conversely considerable impetus to sound forest management will result from amelioration of adverse or uncertain economic influences.

The Influence of Forest Cover on Streamflow and Water Supply

The problem of adequate supplies of suitable water for the industrial sections of the Northeast is one whose importance can not be overemphasized. In fact, water is likely to be the limiting factor in future community development in much of this region. Quality of the water may be of as much importance as quantity and regularity of flow. Turbidity, for example, not only involves cash expense for chemical treatment, but may affect adversely a number of industries requiring pure water for technical purposes. Stability of streamflow is a matter of importance, not only in maintaining water supply in periods of drought but also in connection with the many installed and potential power developments, as well as for maintenance of optimum conditions in fishing streams and at inland water recreational areas.

Recurrence of diastrous floods on many streams in the Northeast has led to the initiation of surveys of watershed conditions under the Flood Control Act of 1936 to locate critical areas contributing to floods and to determine what measures of control or adjustment of land use may be desirable to minimize flood damages. Work on flood control surveys has emphasized very strongly the need for comprehensive research in forest influences to provide basic information for evaluating the effect of different types of cover on erosion, run-off, accumulation, and retention of snow, and penetration of frost.

Preliminary consideration of some of these problems indicates the need for coming to grips with detailed relationships rather than broad generalities. The kind of forest, its stage of development, and the way it is managed all appear to have a significant influence on the water problem in one way or another. Evidence is accumulating to show that the character and structure of forest soils, and hence their permeability, are definitely influenced by the character and composition of the forest they support, this influence being expressed in part through an abundant but inconspicuous fauna inhabiting the soil itself.

The evaluation of the characteristics of a watershed which determine its saturation point also appears to be important. Until this saturation point has been reached, floods are unlikely to occur. Beyond the saturation point, sub-surface run-off may assume importance comparable to surface run-off thus exagerating the volume of flow from a given amount of additional rainfall.

Understanding of the many complex relationships between forest cover and stream flow or water supply will require years of careful study, the initiation of which should not be longer delayed.

STATION PROGRAM AND PLANS

Although the work of the Northeastern Forest Experiment Station is aimed at the basic problems outlined above within the limitations of current finances, consideration of the work under way in relation to this broad view of the region and its problems brings out clearly the inadequacy of the present program and indicates the fields in which it needs strengthening.

Advisory Council

In the development of its program and in coordination of research by other forestry agencies in the region, the Station is assisted by an advisory organization known as the Northeastern Forest Research Council. This Council, serving at the invitation of the Secretary of Agriculture, is composed of State Foresters, heads of Forestry Schools, directors of Agricultural Experiment Stations, representatives of the forest industries, and other business and professional men interested in the development of forestry in the Northeast. The regular annual meeting, held in New Haven, Connecticut, on December 1 and 2, 1938, was followed by a special meeting on January 28, 1939, to give more detailed consideration to financial aspects of the station program. Problems resulting from the hurricane and the need for research on the utilization and marketing of forest products in the Northeast were the major topics for discussion at the December meeting. Much interest was aroused by a report on the first year's operation of the Otsego Forest Products Cooperative Association, Inc., at Cooperstown, New York. The work in forest genetics and flood control surveys was also reviewed at this meeting.

Experimental Forests

Six experimental forests have been established by the Northeastern Station as centers for work and demonstration areas in different parts of the region. Concentration of much of the long-time experimental work in forest management on such areas, under complete control of the station, not only safeguards such experiments from outside interference but also leads to greater efficiency and better correlation of different lines of investigation in the same locality. It also permits accumulation of more detailed information concerning the meteorological and ecological conditions under which the experiments are conducted. The six areas are as follows:

1. The Gale River Experimental Forest, of 1,320 acres, in the White Mountain National Forest, New Hampshire. Used primarily for studies of the management of spruce and fir. Utilization road system completed. Equipped with good set of buildings, but still needs a year-long dwelling for the resident superintendent.

2. The Bartlett Experimental Forest, of 2,600 acres, in the White Mountain National Forest, New Hampshire. Devoted primarily to the management of northern hardwoods. About one mile of rather expensive construction needed to complete the projected utilization road system. With a small addition to project leader's house, buildings will be adequate for present needs.

3. The Massabesic Experimental Forest of 2,485 acres in two units near Alfred, York County, Maine. Representative of the white pine type. Acquisition of additional acreage badly needed to consolidate holdings which are now interspersed with land in other ownerships. Has suitable administration building and garage, but needs a staff dwelling and workshop. Utilization road development in progress but not more than 25 percent completed. Necessary mileage high in relation to acreage because of scattered and irregular holdings.

4. The Hopkins Memorial Experimental Forest, of 1,625 acres at Williamstown, Massachusetts. In the transition zone between oak and northern hardwoods. Being developed primarily for work in forest genetics and the influence of forests on streamflow. Further acquisition desirable under Title III of the Bankhead-Jones Act, to wipe out one interior ownership and to improve southern boundary. Old buildings are being remodeled to meet administrative needs and to house a CCC side camp. Greenhouse, heating plant, and new water system are still needed. Truck trail development begun during 1938.

5. The Chenango Experimental Forest, of 1,465 acres, in one of the New York State reforestation areas near Norwich, New York. Devoted chiefly to forest planting investigations. Has small staff dwelling and garage but needs administration building, additional garage space and workshop. Road system only partially developed.

6. The Finch-Pruyn Experimental Forest, an area of 623 acres in the spruce and northern hardwood types, near Newcomb, New York, made available by cooperative agreement with Cornell University and Finch-Pruyn and Company of Glens Falls, New York. Has small staff dwelling and garage, adequate for immediate needs. Truck trail system almost half completed.

Losses in the 1938 Hurricane

The hurricane of September 21, 1938, dealt a serious blow to the long-time forest management investigations of the Northeastern Station because 70 percent of the 663 permanent sample plots which had been established for management studies other than planting lay within the hurricane zone. Many of these plots had been under observation since 1905 and 1906, those established at that time being among the first study areas set up in this country. More than half of the plots within the hurricane zone were damaged; some will have to be abandoned; some may be cleaned up so as to have further value with changed objectives, while others were only slightly damaged. The accompanying table summarizes the damage by projects. It will be noted that plots in the white pine types were most severely damaged, only about 2 out of 51 within the hurricane zone escaping the effects of the storm. Plans are being made to clean up and retally all the plots which have any further value and to prepare final reports on those which were completely destroyed.

Of the six experimental forests, the Gale River and Bartlett areas suffered serious damage. The Massabesic Experimental Forest, while lying in the eastern edge of the affected zone, suffered very slightly. The Hopkins Memorial Experimental Forest, lying to the west of the storm center, while affected by the heavy rainfall suffered practically no damage from wind.

On the Gale River Experimental Forest about 25 percent of the entire growing stock was windthrown, damage being complete over large areas. A survey indicates that approximately 3,000 cords of softwood and 4,000 cords of hardwood are on the ground. On the Bartlett Experimental Forest hardwoods were damaged to the extent of about 9 percent and softwoods about 11 percent, resulting in a loss of approximately 6,500 cords of hardwood and 1,100 cords of softwood. Heaviest damage occurred on the high slopes where losses by compartments reached a maximum of 35 percent for softwoods and 18 percent for hardwoods. At Gale River the value of most of the intensive experimental work which had been established has been lost. At Bartlett, on the other hand, much of the experimental work can be carried forward with little change in original concepts.

It will be necessary to make a complete reinventory of both the Gale River and Bartlett Experimental Forests. This should be done early in the coming season if possible, but will only be effective after salvage or clean-up of windthrown material is complete. Progress with clean-up, except in strips along the roadsides, has been discouragingly slow because of the inadequacy of available labor and inability to negotiate any large sales. With special funds becoming available through the deficiency appropriation, the job will be tackled with renewed vigor. Consideration is also being given to the possibility of salvaging some of the material by government logging projects should money be appropriated for that purpose in the next fiscal year. Without doubt, much of the down timber will have to be left on the ground to rot.

SUMMARIZATION OF HURRICANE DAMAGE TO EXPERIMENTAL PLOTS BY PROJECTS

Project	Total No. Plots	No. Plots within Hurricane Zone	No. Plots Undamaged	No. Damaged Plots: To be continued with: Original Objectives	No. Damaged Plots: To be continued with: Changed Objectives	No. Damaged Plots: To be abandoned	Percentage Seriously Damaged: % of Total Number	Percentage Seriously Damaged: % Number in Hurricane Zone
Spruce Management	337	156	83	30	14	29	12.8	27.6
Oak Management	60	60	22	30	0	8	13.3	13.3
White Pine Management	58	51	2	4	20	25	77.6	88.2
Northern Hardwoods	99	89	55	9	20	5	25.3	28.1
Spruce Yield Study	24	22	7	5	3	7	41.7	45.5
TOTALS	663	463	224	97	62	80	21.4	30.7
Percentage of all plots:	100	69.9	33.8	14.6	9.4	12.1		
Percentage within hurricane zone:		100	48.4	20.9	13.4	17.3		

Management of Spruce Types

When studies in the management of spruce types were first initiated, the principal concern was the development of a silviculture which would successfully regenerate spruce stands. The types of most common occurrence usually support an abundance of advance reproduction. Successful management therefore lies mainly in protecting the young growth from logging damage, from subsequent windthrow and fire, and from excessive shading and crowding by hardwoods. However, regeneration of stands with strong admixtures of northern hardwoods, particularly those in which sugar maple and beech predominate, and of dense, even-aged stands of spruce and fir is much less simple. For the latter, a light initial cut removing one-fourth to one-half the stand may be expected to lead to the establishment of softwood reproduction under the shelter of the residual stand. Ten to fifteen years later when reproduction is fully established, the remainder of the old stand may be cut. For mixed stands of spruce and northern hardwoods without an adequate understory of advance reproduction of softwoods, no method of cutting will with any certainty prevent an increased representation of hardwoods in the succeeding stand.

Conditions affecting the establishment of spruce reproduction on cut-over areas have been studied over a period of more than ten years by sowing of definite quantities of tested seed on spots representing the principal variations of the natural seedbed. This study reveals that changed seedbed conditions and dense stands of hardwood sprouts, together with invading brush growth, discourage establishment of spruce and fir following cutting. Where the ground has been broken up and competing vegetation is not too aggressive, the new seedlings may gain a foothold within the first year or two following cutting, but with each passing year conditions become less and less favorable for their establishment.

Attention has also been directed to cultural measures for increasing the growth of spruce and improving the composition and quality of spruce stands. Girdling of defective, overtopping hardwoods has been shown to be effective in stimulating the rate of growth of spruce and has been widely used by both public and private agencies. Experiments have also been undertaken dealing with the technique and results of weeding and poisoning as a means of eliminating undesirable tree species, and of the effects of drainage upon growth in a spruce swamp.

Studies of slash resulting from commercial logging operations being conducted in cooperation with the Bureau of Plant Industry show that heavy slash, aside from the fire hazard it represents, forms so dense a cover under certain conditions that it effectually smothers out the advance reproduction beneath it. Slash disposal measures should aim to reduce the density of slash by scattering or burning to a point where it is no longer a deterrent to reproduction. Of the 130 fungi known to attack spruce trees or wood, data have been gathered on the significance of over 100 in respect to the rotting of slash. A special study of fire hazard from spruce slash on areas cut over during the past 30 years is being made for the White Mountain National Forest. Most red spruce slash areas below 2,750 feet in elevation will remain extremely dangerous for 5 years. By 13 years the smaller branches and debris are gone, but a high degree of danger still exists. By 17 years rot has progressed sufficiently and reproduction has grown high enough so that the danger is reduced to a medium condition. By 21 years the fire danger is low, but the areas may not be considered safe as far as slash is concerned until after 29 years. In general, an additional 2 or 3 years are required at elevations above 2,750 feet for conditions to reach a given degree of safety. This study will be extended during 1939 to obtain additional data on the effect of slope and aspect.

Although spruce is now primarily used for pulpwood in the Northeast, there is reason to believe that it will be in demand for lumber again on an increasing scale as Douglas fir from the Pacific Northwest begins to mount in price with exhaustion of the more accessible stands there. Second growth spruce is generally superior to second growth white pine from the North or second growth yellow pine from the South. Spruce sawtimber will therefore be in very good competitive position. Accordingly, it seems desirable to initiate experiments directed at the management of spruce stands for sawtimber production. Such experiments are in line with the general thesis previously set forth--that best results in forest management may be expected when sawtimber is the primary objective, and when outlets for pulpwood and other products serve to utilize material from thinnings and improvement cuttings and portions of crop trees not suited for sawlogs.

A group of compartments on the Gale River Experimental Forest with second growth stands varying considerably in density, age, and composition have been set aside for this purpose. The most promising crop trees in the 4- to 8-inch diameter groups were pruned. Hardwoods were removed to release spruce and fir from overhead competition and increase the yield of softwoods. Eventually it was hoped to develop, by a series of light selective cuttings, a many-aged stand yielding a continuous sequence of large-sized crop trees with butt-logs almost entirely free from knots. Attainment of this objective received a drastic set-back in the heavy damage to these compartments by the hurricane. The area carrying trees larger than small sapling size is now so small and scattered that it seems advisable to locate a suitable tract of second growth spruce forest elsewhere in order to permit more effective progress with studies of spruce sawtimber management.

As a corollary of the experiment in sawtimber management on the Gale River Forest, a series of partial cuttings varying in intensity from 10 to 60 percent of the basal area were arranged in a commercial timber sale in an even-aged stand of spruce and fir about 65 years old and about 90 acres in extent. A record was kept of operating costs for each degree of cutting. Just as was the case in the white pine production cost study, so long as there was no road building to be done, costs were not materially affected by the degree of cutting. These findings are significant because commercial operators so frequently cite supposedly higher costs as a barrier to any form of partial cutting. This series of cuttings was also of interest as illustrating the extent to which commercial logging operations may go without detriment to scenic or aesthetic values. In some respects the area was more attractive after the cutting than in its natural state. However, the residual stand on all except a small portion of the tract was destroyed by the hurricane.

Soil Fauna

During the past two years exploratory work in the little known field of the fauna of forest soils in spruce types has been under way. Attention was first directed toward the mites and other microarthropods which constitute the rather prolific population of the forest floor to determine what part these creatures may play in the reduction of the litter and of the deep accumulation of raw humus which occurs so frequently in the spruce types. As a basis for comparison with other conditions, careful analysis has been made of the fauna in a typical virgin stand. While several species of mites and fly larvae have been found tunneling out the interiors of spruce needles, the really significant part of the problem appears to be the reduction of the raw humus rather than the litter. In this the microarthropods alone are not effective. For this reason attention during the coming year will be directed to study of earthworms and millipedes which are believed to be more important agents in soil building. The significance of these animals is indicated by the finding of mull soil and the absence of raw humus accumulation in a spruce stand on limestone soil where earthworms were present. The significance of the soil fauna is further indicated by the finding that the fertile black humus layer in forest soils consists almost entirely of feces, being organic matter which has passed through the digestive tracts of countless generations of animals of the soil and overhead canopy.

Management of Northern Hardwoods

The major effort in the management of northern hardwoods is being directed toward determining the extent to which selective or partial cutting may be substituted for the clear-cutting now in general practice. Early attempts at partial cutting were followed by serious decadence of the residual stand, especially marked in the case of yellow and paper birch. This decadence was found to be attributable only to inability of the trees to adjust themselves to a radical change in environmental conditions. Experimental thinnings removing not over 40 percent of the volume have not been followed by serious deterioration. Relatively light cuttings, therefore, do not dangerously expose the residual stand, but marking must be judiciously handled to avoid loss of yellow birch.

On the Bartlett Experimental Forest an experimental series of selective cuttings have been in progress for six years, one five-acre block of many-aged northern hardwood forest having been treated in each of four years, removing from 24 to 34 percent of the total cubic volume. In an adjacent compartment a comparable five-acre block was clear-cut in each of the first three years, but additional clear-cutting will not be undertaken until the second cutting cycle on the selection plots, which should be in about 15 or 20 years from the initiation of the series. On the areas where a partial cutting was made the residual stand has shown little response, but the small saplings and the reproduction have become more vigorous, especially in the openings. The openings appeared to be responsible for considerable damage during the hurricane because losses in the treated areas were definitely greater than in adjacent untouched stands. On the clear-cut areas much of the advance reproduction was killed by exposure in the first two years, but this was promptly replaced by a new crop of seedlings in which yellow birch was abundant. Weed species are characteristically predominant.

On some of the cut-over areas the existing hardwood reproduction has been cut back with a brush scythe to determine whether this would result in a new stand of improved form and more rapid growth. The results appear quite satisfactory, especially on the clear-cut area where such a practice would have its best application. Other mowings have been made in stands prior to the time of cutting. This should not only prove more economical, but will provide stimulation to the desirable advance reproduction without interfering with the species which seed in immediately after cutting.

In an effort to combine the advantages of both clear-cutting and partial cutting, another compartment is being handled on a group selection basis. An area of about twenty acres was worked over each of the past two winters, removing the stand from 10 to 15 percent of the area in irregular openings varying from 0.1 to 0.7 acre in size. In most of these openings reproduction is developing very well, and competition from the weed species which spring up so prolifically on large openings has not been severe. The plan is to make similar cuttings in the stand at intervals of perhaps 15 years. Extension of this practice to the rest of the compartment will be postponed until clean-up of timber windthrown by the hurricane has been completed.

Experiments with partial cutting are also under way on the Green Mountain National Forest near Danby, Vermont.

Another important problem in the management of northern hardwoods is the treatment of young stands on cut-over areas. In such stands the more desirable species are often in the minority and are subject to suppression by the less valuable species and weeds. Weeding offers promise of improving the composition of these new stands and of stimulating the growth of the more desirable elements. On the Bartlett Experimental Forest, a series of 17 plots have been established to study the weeding problem in areas cut for fuelwood 4 to 10 years previously. Some of the points which these plots should clarify are: (a) period after logging when weeding will be most effective; (b) amount of freedom desirable for crop trees; (c) best method of accomplishing the weeding; (d) effect of treatment on composition and growth of the stand. Examination after 5 years indicates that nothing is gained by cutting back more than the stems in direct overhead competition with the crop trees. For this cultural work cutting at any convenient height is superior to poisoning. The areas recently clear-cut will provide an excellent opportunity for additional weeding studies on areas free from the influence of even a scattered residual stand.

Management of Pine Types

Plans for the pine management project are being centered about the development and control of an adequate growing stock for the production of high quality sawtimber. Indiscriminate clear-cutting, resulting in deterioration of quality or conversion from pine to hardwoods, has had an adverse effect upon the lumber industry in the region and consequently upon the dependent rural communities. Selective cutting and integrated utilization offer prospect of ameliorating this situation. In order to obtain preliminary information on growth, reproduction conditions, and optimum volume of growing stock under selection management, studies will be made of the few properties in the white pine region which have been selectively cut in the past. Methods of logging adaptable to the selection system of management for pine types should be developed. To this end an experiment in tractor yarding of cordwood was undertaken on the Massabesic Experimental Forest during the fall of 1938.

Experience of the past indicates that pure stands of pine are not as desirable as mixtures of pine and hardwood. Since a delicate balance exists on many soils between white pine and hardwoods, careful study of the factors affecting this balance is needed to permit forest managers to maintain a high proportion of pine in the growing stock and produce the best quality timber. Natural pruning, prevention of sunscald, protection from white pine weevil and gypsy moth are among the factors which need consideration in the treatment of young pine and hardwood mixtures.

Although considerable pruning and thinning investigations have been conducted in pure, even-aged stands of red and white pine, including plantations, very little work of this nature has been done in uneven-aged mixtures of pine and hardwoods such as are likely to be obtained under a selective cutting system. Experiments in pruning of selected crop trees in uneven-aged mixtures were initiated on the Massabesic Experimental Forest in 1937. Improvement cuttings aimed at developing resistance to gypsy moth as well as improving composition, form, and growth have also been undertaken on that forest. Most of the older thinning and pruning experiments being conducted by the Northeastern Station were destroyed by the hurricane.

The pitch pine plains, most extensive in southwestern Maine, but also occurring elsewhere in the region, present a special problem in management. Resulting from recurrent burns, these plains now support a scattered, inferior stand of pitch pine and, in some localities, scrub oak. In Maine some of these lands are burned annually to stimulate blueberry production, thus placing them outside the sphere of forest management. Since they are capable of supporting good stands of pine timber, methods of protection and management should be developed to restore these areas to productive condition, where not used for blueberry growing.

Mensuration

The intelligent application of forestry technique to any forest property is predicated on a management plan based on factual data on growing stock and rate of growth. Inventory of existing stock is simple, but the forecast of changes due to growth is complicated by the interaction of species, age, productive capacity of the land, density of stocking, etc. Furthermore, determination of net growth must consider normal losses from suppression, insects, fungus, normal windfall, etc.

The physical effort of extracting, counting, and measuring an increment core is much greater than that of measuring a tree for inventory purposes, and numerous borings are needed to establish growth rates to a reasonable degree of accuracy. Such laborious work, however, has been a regular adjunct to management plan surveys on the national forests, on our experimental forests, and wherever sustained yield management is contemplated.

About three years ago the Station undertook an investigation to determine whether it would be possible to assemble growth data in a form adaptable to any stand in the northern hardwood region, using criteria such as species, age, site, density, and volume. Growth studies conducted at the request of the Regional Forester for both the Coos-Essex (New Hampshire-Vermont) and Tioga (New York) cooperative marketing projects were planned to permit analysis of the various factors affecting growth. Specific growth rates for the areas were provided, with estimates of mortality incorporated.

In this investigation mortality is the most difficult factor to evaluate. It can not now be determined accurately from the temporary plots which provide data on all other growth factors, and the variance of this factor is large in comparison with the variance of the usual growth factors, thus requiring extensive data for adequate analysis. Data now available do not appear to be adequate for evaluation of the effects of age, density, site, etc. A key of rather limited application for estimating time since death was developed during the study, but the only completely reliable sources of mortality data are permanent sample plots on which all trees are numbered. Permanent cruise plots with unnumbered trees are not satisfactory since it is difficult to mark dead trees positively, while determination of losses by differences between successive tallies requires extreme accuracy of tally, since a 1 percent error in number of living trees may amount to 10 to 50 percent of the difference between tallies (mortality). A simple and reliable means of determining time since death or of expressing the relation of mortality to presence of standing dead trees is needed, and data for this purpose are now being taken during remeasurement of permanent plots.

Studies are also in progress of the yield of northern hardwoods in even-aged second growth stands, of the growth of spruce and fir on cut-over lands, and of the approach of understocked stands of second growth spruce and fir to normal. Technical advice is still being made available in the conduct of the survey and type map project being conducted by the CCC in southwestern Maine. High standards of accuracy have been maintained in the inventory phase of this CCC project.

Forest Planting

With the large areas which have been dropped from cultivation in the past and the rapid readjustment of land use still in progress in this region, particularly in New York State, forest planting ranks as a major forestry activity. The Northeast has engaged in forest planting on a large scale for many years, and successful techniques for planting conifers have been evolved in this work; but there is a real need for intensive research which seeks to determine the causes contributing to planting success or failure, in addition to mere development of efficient planting routine. The station work now is directed toward (a) methods of establishing hardwoods and mixtures of hardwoods and softwoods, (b) methods for successfully planting areas of poor drainage and heavy competition, (c) elimination of competition of weed tree growth by poisoning, (d) tests of apparently superior stock from seed of known origin, (e) establishment of plantations by rooted and dormant hardwood cuttings, using hybrid poplar stock, and (f) increasing the success and reducing the costs of field plantings. Some of the effects of improper planting technique have been determined. By modification of seedbed density, the seedling stock may be adapted to a much wider range of field conditions without transplanting. More efficient methods of experimentation will be applied to permit separate evaluation of the several factors contributing to plantation establishment, and greater emphasis will be placed on the determination of basic reasons for success or failure, rather than the developments of methods of limited application.

Forest Protection

Consideration of forest fire statistics for the Northeastern states for the decade ending in 1935 indicates that material progress has been made in the protection effort. In spite of the fact that the latter part of the decade was relatively unfavorable from a climatic point of view, there has been a marked decrease in the area burned annually and in the average size of fires. Some of the states are already well within the standard of allowable burn set up by the Forest Service. In the light of this improvement in fire experience and of the relative importance of the fire problem in this region, it is not believed that forest fire research merits major emphasis any longer. Early in 1938 the situation was discussed fully at a conference with state foresters, their chief forest fire wardens, the Regional Forester, and members of his organization. It was generally agreed that the Station should confine its attention chiefly to its study of ecological effects of fire and the determination of standards for the appraisal of fire damage.

In addition, a study of the rate of spread of fire, particularly in slash on cut-over areas, was suggested. Early in the spring arrangements were made with the Massachusetts Conservation Department and the CCC for some experimental burning of slash on areas stripped of timber in the Quabbin Reservoir basin. When the time for burning approached, a ban on all outdoor fires was declared because of abnormal danger and the experiment was abandoned. Because of the difficulty of obtaining full cooperation, it seems useless to attempt such an experiment again.

The need of administrative organizations for a single fire-danger meter to give comparative ratings for all forests in the region led to collaboration with the Appalachian and Allegheny stations in the synthesis of such a meter from basic data already available. There will be opportunity during the coming year to compare the value to the local protective organizations of this new meter and the meters previously prepared for specific forest types.

As a result of the 1938 hurricane, New England faces the most acute fire protection problem in its history. The seriousness of the situation has led to more intensive arrangements for gathering and forecasting of fire weather and danger information. In this, the new Eastern Mountain Region fire-danger meter will come into immediate and widespread use. To stimulate individual owners to clean up their own woodlands, the Agricultural Adjustment Administration has offered a special benefit payment of $4 per acre up to 15 acres per farm. The practice for which payment will be made is based partly on reduction of fire hazard and partly on restoring damaged stands to more productive condition. Recommendations of the Northeastern Station were followed in setting up the standards of performance to qualify for payment, and representatives of the Station participated in several meetings for training of field supervisors in the administration of this practice.

Forest Genetics

The forest genetics program aims to aid both selective silviculture on the extensive areas of forest land which will never be artificially replanted and the rehabilitation of deforested or poorly stocked land by planting. Progeny tests to determine the heritability of important characteristics of native species and criteria for inherent excellence of individual trees will supply the information needed by the practicing forester for adequate marking of stands for thinning, weeding, and final cutting. The ideal obviously is to leave the inherently excellent stock for reproduction of successive generations and thus to achieve improvement of the stand through mass selection from generation to generation.

Hybridization and breeding are aimed at the creation of improved forest tree types for use in the reforestation of submarginal farm lands, deforested areas, or areas which are being taken over by inferior species. This hybridization and breeding work will also supply data on inheritance and the mode of inheritance in forest trees, which can be applied to mass selection in native stands.

The breeding program includes a search for outstanding individuals in the native forests which will be used in intraspecific as well as interspecific breeding. Hybridization between species offers outstanding possibilities in a field as new as forest tree improvement, not only because it is possible to combine the desirable characteristics of different species but because first-generation hybrids are often more vigorous than either of their parents.

As a result of breeding work in 1937, almost 800 seedlings from interspecific pollination of Betula, 127 of Magnolia, 38 of Acer, and 9 of Quercus are now growing in the nursery at the Hopkins Memorial Experimental Forest. During 1938 hybridization was extended to other genera. A large amount of exploratory work is necessary in connection with the breeding of forest trees in order to determine blooming time, flower behavior, and other characteristics of the reproductive process. Dichogamy has been found to make self-pollination impossible in the maples, oaks, birches, and hickories.

Since all of the excellent characteristics of a wild individual or of a new hybrid can be immediately maintained by vegetative propagation, the Station has also undertaken research dealing with the stimulation of rooting from cuttings of forest tree species. Very satisfactory results have been obtained in rooting greenwood cuttings of sugar maple and red maple, while partial success has been obtained with white birch, yellow birch, and basswood. Attempts to root white pine have thus far been unsuccessful here.

In the initiation of a search for excellent individuals of forest trees, particular efforts have been made to locate sugar maples which produce a high percentage of sugar in their sap. The maple sugar industry is important in the region, and if outstanding sugar maple trees are found and can be reproduced from cuttings, such stock will find a ready market throughout New England.

The Northeastern Station is cooperating with the Oxford Paper Company in continuing the genetics research with hybrid poplars started by this corporation in 1924. Many new hybrids are available which offer outstanding possibilities from the standpoint of vigor and of resistance to disease and environmental conditions. The Station has leased the Oxford nursery at Frye, Maine, and produced approximately 250,000 cuttings of the new poplar hybrids during 1938. The best of these hybrids are being tested throughout the country by cooperation with Forest Service and Soil Conservation Service nurseries. A total of 58 individual hybrid clones are being tested at 25 nurseries, the number of hybrids sent to any one nursery varying from 15 to 25.

Forest Products

Production Cost Studies

An important aspect of the broad problem of improving forest growing stocks through selective cutting is revealed through analyses of costs of producing lumber and other products from trees of different sizes and through study of the effect of selective or partial cuttings upon operating costs. Results of analyses of six northern white pine and three northern hardwood lumber operations, conducted in cooperation with the Forest Products Laboratory, have been reported in previous years. Work of the Northeastern Station on farm pulpwood operations in second growth spruce and fir was also summarized in the Annual Report for 1936.

From these studies it appears that, for accessible stands, where large outlays for road construction are not required, operating costs are affected little, if any, by partial cutting. The analyses point toward the desirability of a forest management policy which will maintain a well stocked, thrifty stand containing a substantial proportion of trees in the larger size classes. Under such an objective cutting may well be selective in character, confined largely to mature trees over 18 inches in diameter and taking trees of smaller size only when necessary to improve growing conditions or quality of the residual stand.

Attention has also been given to the development of log grades for both white pine and northern hardwoods in collaboration with the Forest Products Laboratory. This work provided a basis for log grades adopted by the Northeastern Timber Salvage Administration for use in the purchase of timber windthrown by the 1938 hurricane. The hardwood rules are based on a new concept in which grade is determined by defect-free cutting lengths in each of four separate faces of the log.

Difficulty was experienced in the northeastern hardwood studies in finding mills where the bulk of the product was being put into 1" and 2" lumber. This led to the conclusion that future work of this sort should be directed at study of economic recovery in different forms and combinations of utilization rather than at the production of lumber alone. The results also point to the advisability of substituting cubic measure for board measure in order to have a unit of more general and uniform applicability.

Forest Economics

Cooperative Management and Utilization for Farm Woodlands

In an effort to meet the farm woodland problem outlined in a preceding section, the Station has under way a project dealing with cooperative management and utilization at Cooperstown, New York. Based on preliminary studies of the local situation by the experiment station and sponsored by the Cooperstown Chamber of Commerce, woodland owners in the vicinity organized the Otsego Forest Products Cooperative Association, Inc. Starting with a small interested group, this Association had 232 members with a forest area of about 10,000 acres by the time woods operations got under way in the fall of 1937. Membership at the close of 1938 was 300.

Common stock in the cooperative association can be acquired only by those engaged in producing forest products. After an initial subscription it is issued in part payment for products delivered to the Association under a revolving plan which will keep control in the hands of active producers and at the same time provide flexibility of capital. Each member has only one vote no matter how much stock he may own. Authorized capital, in shares of $1 each, consists of $50,000 in common stock and a like amount in preferred stock which may be issued to anyone, but carries no vote. About 4,000 shares of preferred stock have been purchased, mostly by citizens of Cooperstown. Members must agree to sell all their forest products except fuelwood through the Association, and to manage their woodland according to sound forestry principles set up by the Association.

As a basis for the system of forest management adopted by the Association, the experiment station has made an analysis of the forest resources on the individual properties of most of the members. In this work a new, rapid, and cheap system of farm mapping and woodland inventory has been evolved, which should have wide application in sustained yield management projects in all sections where the country is subdivided into small irregular ownerships. It is estimated that the total cost of forestry control provided by this system, including marking of trees to be cut, will be from 8 to 10 cents per cord. The system of marking being applied aims to improve the quality and growth rate of the stand by light selective cuttings, taking trees of low vigor or poor quality in all size classes. The amount designated for removal at any one time is equivalent to the growth of only 3 to 5 years. Under this system it is evident that a relatively large acreage, involving a correspondingly large number of owners, must participate in the cut each year in order to obtain a given volume of product.

During the first season 85 members brought in about 750,000 board feet of sawlogs for manufacture by the temporary mill which had been set up primarily to prepare material for construction of the main plant, which should handle at least 3,000,000 board feet a year. The amount cut per farm averaged about 8,000 board feet Doyle scale. With average price for all species and grades at about $20 per thousand, net return to members for stumpage, profit, and risk averaged about $9.30 per thousand. An analysis of income and out-of-pocket expense for all activities on the farms which participated during the first season indicates that net cash income was raised from $400 to $553 by the woods activity. Since the cut of merchantable sized material was about equivalent to the growth of 2 years, the annual addition to income from this forestry enterprise would be about 20 percent.

The benefits to the community as a whole are not so readily evaluated. An indication of the general economic level, however, was obtained in one township where 35 of the 85 initial operations were concentrated. By referring unemployed men to farmers needing labor for woods work, the town supervisor reduced relief costs from $279 in January to $40 in March, a period when there is normally an increase in relief expenditures.

To provide capital for initial operations and to finance the construction of an efficient processing plant especially designed to handle the varied classes of material yielded by the woodlands of the members, the Association has borrowed $160,000 from the Farm Security Administration. Responsibility for technical supervision of this loan has been placed in the Forest Service, and the Association has sought the guidance and advice of the experiment station in every phase of its activities. Labor policy, purchase policy, accounting practice, plant design, log grading and prices, forestry methods, and a program of membership education have all been largely developed for the Association by the station.

The most distinctive feature of this project is that it attacks the farm woodland problem simultaneously on all fronts. Advice and guidance in the management of the woodland is integrated with improvement of facilities for converting the products into most salable form and analysis of available markets. Technical practices, operating methods, and management problems are all being subject to study so that it should be possible to evaluate the results in a more satisfactory way than if attention were restricted to any one phase of the problem.

In addition to the direct benefits to members and to the local committees, this project has a significant relationship to the basic program of the Department of Agriculture. With major objective identical with that of the Department as a whole, namely, to raise the economic level of the agricultural population, it is functioning in a field where other activities of the Department are creating subsidiary readjustment problems. On the one hand, the Department has purchase programs aimed at removing from cultivation land on which a decent standard of living can not be maintained. Even in sections where a permanent agriculture is to be maintained, readjustments in land use to prevent or check soil erosion and the stimulation of increased production and better management of good lands by the Soil Conservation Service, the Agricultural Adjustment Administration, and the Extension Service are continually releasing land from cultivation. Unless channels are established so that forestry on these lands may yield an income, they must still be considered an economic liability only partially justified by the indirect social benefits inherent in maintenance of a forest cover.

On the other hand, both the removal of land from cultivation and technological increase of production tend to release rural labor from the usual agricultural pursuits and thus create additional problems of readjustment. The development of a program of sound forest management, such as that being worked out by the Northeastern Station in connection with the operations of the Otsego Forest Products Cooperative Association, Inc., not only will provide an economic use of land unsuited for other purposes, but also offers the most logical means of providing employment to the rural labor being released in the process of agricultural adjustment. In the first place, forest products being bulky require a high percentage of labor in relation to their value and are most economically processed near their source. In the second place, the production of forest products is largely non-competitive since the forests of the country have not yet been placed on a sustained yield basis, and rate of exploitation exceeds annual growth, especially in the case of better quality hardwoods. Furthermore, local production of forest products used on the farms is distinctly advantageous because logs or other agricultural products may be exchanged for needed lumber with no cash involved in the transaction. All values are thus kept within the community.

Finally, successful forestry enterprises of this sort will serve the objectives of the Department by minimizing the need for land retirement. The added income available to farmers from regular sale of forest products and part-time employment in forest industries will enable many otherwise submarginal farm units to supply a satisfactory standard of living.

Forest Insurance

The study of forest fire insurance, first undertaken in the Pacific Northwest, has been completed in the Northeast. Field work in this region included the states of Maine, New Hampshire, Vermont, Massachusetts, New York, and Pennsylvania. The study shows that there is ample opportunity for entirely practical forest fire insurance in this region as is the case in the Pacific Northwest. The results of the Northeastern study will be presented in a report suggesting a single rating schedule for the entire region.

After a preliminary canvass of the principal timberland owners both in the Pacific Northwest and the Northeast, negotiations for the organization of an underwriting pool to offer business simultaneously in the East and West were undertaken with the National Association of Insurance Executives. Positive action was not taken by this group because of uncertainty as to the financial status of the lumber industry in the West and the conflagration hazard there. One of the larger companies, however, maintained an independent interest in the opportunity for initiating business in the East. Additional promotional and educational work with agents of this company was in progress at the time of the hurricane in September. The extreme hazard, combined with substantial reduction in timber values in the territory where it was believed the best opportunity for initial underwriting existed, led to postponement of further action.

Flood Control Surveys and Forest Influences

The Northeastern Station is participating in activities of the Department of Agriculture under the Flood Control Act of 1936. This work is divided between the Forest Service, the Soil Conservation Service, and the Bureau of Agricultural Economics through a series of committees. The Director of the Northeastern Station is primarily responsible for the work in New England and the eastern part of New York. He collaborates under Soil Conservation Service leadership for the work in the remainder of New York. Thus far, preliminary examinations have been made or are under way on the Blackstone, the Upper Susquehanna, the Merrimack, and the Connecticut Rivers. Detailed surveys are under way on Buffalo Creek in New York and the Merrimack River in New England. These surveys aim to determine what measures are necessary for run-off and water flow retardation and soil erosion prevention.

The Northeastern Station has no appropriation as yet for research dealing with the influence of forest cover on water supply, streamflow, and erosion. However, advantage is being taken of labor available from the Civilian Conservation Corps and the Works Progress Administration to lay a foundation for such studies by the construction of five weirs for streamflow measurement on the Hopkins Memorial Experimental Forest at Williamstown, Massachusetts, and one on the Chenango Experimental Forest near Norwich, New York.

Forest Insects

(Bureau of Entomology and Plant Quarantine)

As mentioned in the introductory section, protection of forests from insects and disease becomes of increasing importance as interest in forest management grows and as fire protection becomes more effective. The Northeast is in a particularly vulnerable position with respect to forest pests because of the heavy traffic entering Northeastern ports from other countries. Over a long period of years it has been faced with a succession of new pests, some of which threaten very serious damage.

The Bureau of Entomology and Plant Quarantine maintains a forest insect laboratory with a staff of eight technical men at New Haven, Connecticut, in cooperation with the Northeastern Forest Experiment Station.

One of the major concerns of the forest insect laboratory at present is the European spruce sawfly which has killed extensive areas of timber in Quebec. During 1938 surveys in cooperation with the states of New Hampshire, Vermont, and New York showed that the sawfly was generally distributed in small numbers in these three states. While the Bureau made no survey in Maine, the state entomologist reported an increase in intensity of infestation in northern Maine and also in Washington County. Serious infestation occurred in Dublin, Peterboro, and Pittsburg, New Hampshire; and in Wilmington, Marlboro, Dorset, Ripton, Lincoln, and Warren, Vermont. In New York a number of medium infestations were found in plantations of Norway spruce in Columbia, Dutchess, Ulster, Otsego, and Chenango Counties. In the Adirondacks the sawfly was quite numerous, but no defoliation was noticed.

Between five and six million cocoon parasites (Microplectron fuscipennis Zett.), reared in the laboratory at New Haven, Connecticut, were colonized in spruce sawfly infestations in Maine, New Hampshire, Vermont, and New York during 1938. Other species of parasites were received in small numbers from the Canadian Parasite Laboratory. Some of these were liberated and some were held for experimental rearing. The State of Maine has established a laboratory for rearing parasites also.

The infestation of Eastern spruce bark beetle on the Green Mountain NationalForest appears to be decreasing. The 1938 hurricane has tremendously increased the danger of bark beetle infestation in the mature spruce stands of the White Mountain National Forest.

Infestations of the forest tent caterpillar, which caused extensive defoliation of northern hardwoods in 1937, continued heavy in 1938, although with less complete defoliation. Many sugar orchards in Vermont show the deteriorating effects of the severe defoliation of recent years and in some localities many trees have had to be removed. The food habits of this insect are to a considerable extent similar to those of the gypsy moth. However, sugar maple, not greatly favored by the gypsy moth, is one of the species most seriously damaged by the forest tent caterpillar.

Studies of the ecology of the gypsy moth are being carried on in four localities, including the Massabesic Experimental Forest. Another line of work includes histological study to determine the nature of injury to plant tissue by sucking insects.

Very promising results have been obtained in the control of several leaf-eating insects in woodlands by the application of insecticides in concentrated mixtures from an autogiro. The autogiro has the advantage over the airplane for this work because it can be flown slower, it is safer over rugged forest areas, and it can be operated from smaller landing fields. The cost of application may be considerably less than from ground equipment and the areas are covered more quickly. Concentrated spray mixtures (proportions by weight, lead arsenate 1 part, water 1.2 parts, an adhesive oil .2 part, and a wetting agent .03 part) were found to be superior to dusts. Further improvements in the autogiro and the distributing apparatus will undoubtedly increase the efficiency of this method of applying insecticides.

Preliminary plans have been made for investigation of insect problems in forest plantations, paralleling similar work being done by the Bureau of Plant Industry. The objectives will be to study the effect of composition, site, topography, spacing, et cetera, on the abundance of insects and the amount of injury in order to determine how to minimize insect damage through forest management. A European pine sawfly (Diprion frutetorium F.) was found for the first time in New England on a red pine plantation at Petersham, Massachusetts, where it appears to have two generations annually. This insect is established in southern Ontario and has been reported from New Jersey. The red pine sawfly (Neodiprion sp.) caused serious defoliation in several localities and continues as a threat to red pine plantations in New England. In Massachusetts many plantations were sprayed to prevent defoliation last year.

Forest Pathology

(Bureau of Plant Industry)

The Bureau of Plant Industry also maintains a field office at New Haven, Connecticut, in cooperation with the Northeastern Forest Experiment Station.

During the past year field work on the study of coppice rots, results of which were tentatively presented in last year's report, was completed by supplementary work on sugar maple, white ash, and yellow birch. Sugar maple was found to be seriously rotted by fungi which have been supposed to attack only dead trees.

The work on Nectria canker and heartrots of balsam fir has likewise been brought to the point of publication of results. Work on slash decay has been covered under the heading "Management of Spruce Types."

The question of danger from decay resulting from the pruning of hardwoods was given consideration in 1938. White and black oaks pruned in 1935 by Professor A. E. Moss of the Connecticut State College provided material for study. Only about 2 percent of the wounds examined contained active decay fungi. The hazard appears very slight for wounds less than 2 inches in diameter, but increases with the size of the wound. The decay hazard was no greater when the cut branches were dead than when they were alive.

A study was also made of decay and discoloration resulting from increment borer holes. Little effect was noted in red spruce, balsam fir, or hemlock. All the northern hardwoods examined except white ash showed discolored streaks and one-fourth showed decay at the holes.

In the study of plantations, a new needle disease of Douglas fir was discovered in southern New England. The fungus causing it appears to be the same as one doing serious damage to Douglas fir in Europe.

Special attention is being given to the progress of sap-stain and decay in timber windthrown by the 1938 hurricane. A leaflet giving information on minimizing loss from these factors has been prepared for public distribution.

Forest Wildlife Relationships

(Bureau of Biological Survey)

A project analysis setting forth the basic considerations for a program of forest wildlife investigations in the Northeast, and including a comprehensive outline of studies under way, was developed during the year. This analysis brings out the importance of the forest areas in the region as vast wildlife reservoirs readily accessible for recreational use by the millions living in the industrial centers of New England and the Middle Atlantic States. The recreational values of wildlife stocks within northeastern forests are increasing yearly. However, the proximity of dense human population has created many difficult problems for wildlife, which are further complicated by the wide range of conditions existing in the forest habitat after 300 years of lumbering and fire. Recreational values, both tangible and aesthetic, are great enough to warrant extended, penetrating research into methods for developing wildlife populations in harmony with other forest uses.

The studies initiated to date have necessarily been on a limited scale, but they are planned to permit future expansion whenever circumstances allow further expenditures. A broad approach to the problems has been maintained, but specific detail is not lost. The yearly unit problem method on which the work plans are based requires definite objectives and adequate reports on progress. Investigations begun so far deal with the evaluation of forest types in the region for forest wildlife production, the effect of forestry practices on wildlife, practical methods of game-food shrub planting to increase the wildlife productivity of coniferous plantations, the relationship of small mammals to spruce forest soils, and several minor projects. An illustrated handbook for the identification of wildlife injury in the Northeast was prepared for publication during the year.

RS - NE
M-1

February 1, 1939

Methods of Cutting in the Spruce Region

1. Field Division: Forest Management.

2. Work Project: Silviculture.

3. Line Project: Harvest Cuttings:Spruce Types.

4. Purpose of Work: To determine the best methods of regenerating spruce stands and to evolve optimum cutting techniques under sustained yield management favoring the development of all-aged spruce stands for integrated pulpwood and sawtimber production.

5. Review of Past Work: Broadly speaking, spruce stands may be segregated into two classes:

   (1) those of most common occurrence which can be easily regenerated through relatively simple and inexpensive measures;

   (2) those less abundant as to area, consisting of:

      (a) dense, even-aged stands of immature spruce and fir, and

      (b) stands with strong admixture of hardwoods in which regeneration presents a difficult problem.

The technique for successfully regenerating stands falling in the first class has been solved. These usually have an abundance of advance reproduction to work with. Successful management lies mainly in protecting the young growth from logging damage, from subsequent windthrow and fire, and from excessive shading and crowding by hardwoods.

The problem of how to regenerate spruce stands falling in the second classification is less simple. In such stands reproduction is generally absent or deficient. Studies so far indicate that second-growth spruce stands should be given a light initial cut removing one-fourth to one-half the stand, permitting the establishment of reproduction under the shelter of the remaining trees. Ten to fifteen years later when reproduction is fully established, the remainder of the stand may be cut. When adequate reproduction of softwoods is not present in stands containing strong admixtures of northern hardwoods, no method of cutting now practicable will, with any certainty, prevent an increased representation of hardwoods in the succeeding stand. Stands in which sugar maple and beech predominate are particularly liable to be unsatisfactorily stocked with spruce and fir reproduction.

Studies of subsequent regeneration of cutover spruce stands reveal that changed seedbed conditions and dense stands of hardwood sprouts together with invading brush growth discourage establishment of spruce and fir following cutting. Where the ground has been broken up and competing vegetation is not too aggressive, the new seedlings may gain a foothold within the first year or two following cutting but with each passing year conditions become less and less favorable for their establishment.

Studies of slash disposal show that heavy slash aside from the fire hazard it represents forms so dense a cover under certain conditions that it effectually smothers out the advance reproduction beneath it. Slash disposal measures should aim to reduce the density of slash by scattering or burning to the point where it is no longer a deterrent to reproduction. Analysis of slash data shows that slash decay is correlated with age, aspect, elevation, and steepness of slope. It appears that softwood slash may constitute an abnormal fire hazard for eight to twelve years.

6. Accomplishments during Past Year: The methods of cutting study suffered a serious setback by the 1938 hurricane. Numerous experimental plots aggregating over 150 acres and representing in some instances over thirty years of study must be abandoned because of excessive windthrow. Retention of many other damaged plots can be justified only on the basis of changed objectives. Nearly 50 percent of the plots lying within the hurricane zone have had their value impaired to a greater or lesser degree. Plots in old-growth and second-growth stands suffered alike. Almost complete destruction of the 90-acre partial cutting experiment on the Gale River Experimental Forest brought to an abrupt halt the conspicuous start made toward obtaining information on the proper management of second-growth spruce stands. Preliminary analysis of logging cost data in this experiment indicated that degree of cutting had little effect on pulpwood cutting and peeling costs.

7. Plans for Next Year: Rehabilitation of the Gale River Experimental Forest and of permanent plots damaged by the hurricane will be the major concern for the next year. This includes the preparation of numerous progress reports. Considering the diminishing importance of old-growth spruce stands, it is not planned to replicate in their entirety the plots lost in the hurricane. Attention will be given to selection of suitable areas to replace the Gale River Experimental Forest as a center for work on second-growth stands.

   The report on the influence of seedbed conditions on survival of red spruce and balsam fir seedlings will be completed. Experiments in selective cutting will be continued on the Finch Pruyn Experimental Forest.

8. Date of Completion: A continuing project.

9. Assignment: M. Westveld.

RS - NE
M-4

February 1, 1939

Methods of Cutting in Northern Hardwoods

1. Field Division: Forest Management.

2. Work Project: Silviculture.

3. Line Project: Harvest Cuttings:Northern Hardwoods.

4. Purpose of Work: To determine the relative merits of clear-cutting, tree selection, and group selection cutting methods in the northern hardwoods type.

5. Review of Past Work: On each of four successive years 5-acre plots in the many-aged northern hardwood types have been cut selectively. Considered as a whole, from 25 to 35 percent of the basal area was removed, while the variation within plot subdivisions ranged from 15 to 40 percent. Comparison plots were clear-cut during three successive years. On a comparable 40-acre block group selection cuttings involve the clearing in small openings of about one-eighth of the total area. In the second year after clear-cutting, pin cherry and other weed species predominated, although there was also a fair stand of sugar maple and other desirable hardwood reproduction. Conditions appear more favorable following the smaller group cuttings as the new stand contains a much higher proportion of valuable commercial species.

6. Accomplishments during Past Year: During 1938 the first 5-year remeasurements were obtained on the clear- and selectively cut series of plots. The development of the new stand following clear-cutting was generally satisfactory, although it was apparent that weeding operations would be essential to bring through a well stocked stand of the merchantable species. Pin cherry was relatively less important than in the first year after the cutting but continued to dominate the stand; other species ranked in order of importance were sugar maple, yellow birch, paper birch, beech, and aspen. Since sugar maple and beech made up more than two-thirds of the advance reproduction, it is evident that the other important species have largely come in following the removal of the overstory. The development of the selectively cut area over the same 5-year period was reasonably satisfactory. Although not accelerated by the treatment, the growth rate of the reserved trees was being maintained even in the larger size classes, and the net growth percentage on the selectively cut plot exceeds that on similar untreated areas. The variations between species were very noticeable; sugar maple and white ash, the two most valuable species, were making excellent growth, while, at the other extreme, yellow birch showed a net loss as the mortality of trees bordering small openings more than offset the growth of the living trees.

An additional 5-acre plot was marked and tallied preparatory to a heavy selection cutting. Preliminary steps, including the mowing of advance reproduction, were undertaken in establishing another series of group selection cuttingson a 20-acre block. As a result of the September hurricane, the actual treatment of both areas was postponed in order to concentrate all available manpower on the timber salvage and fire reduction program.

7. Plans for Next Year: The 1938 hurricane will necessitate a radical change in plans for the next year. In addition to the regular 5-year remeasurement of one of the clear-cut plots, all of the selectively cut series will be tallied to determine how much of the experiment will have to be abandoned. Portions of the area will be retained as an indication of conditions following heavy removal. The basis for evaluating light cuttings having been destroyed, additional cutting areas should be established as soon as practicable in order to again properly round out the selection cutting program.

8. Date of Completion: A period of 15 years should provide a sound basis for weighing the relative merits of the different methods of cutting. The full significance of the project can, however, only be developed by carrying the work through a full rotation.

9. Assignment: Victor S. Jensen.

RS - NE
M-3

February 1, 1939

Methods of Cutting in White Pine Region

1. Field Division: Forest Management.

2. Work Project: Silviculture.

3. Line Project: Harvest Cuttings: White Pine Types.

4. Purpose of Work: To determine the relative merits of different cutting methods in the various pine types of the region.

5. Review of Past Work: A few methods of cutting plots established by the Forest Service in 1906 have been maintained by the Station. Computation and analysis of these plots are in progress.

6. Accomplishments during Past Year; Project in planning stage.

7. Plans for Next Year: Plots damaged by the hurricane will be re-measured. An intensive case study will be made of a privately owned area which has been selectively cut for several cutting cycles.

8. Date of completion: Indefinite. The 1939 case study will be completed during that calendar year.

9. Assignment: H. F. Morey.

RS - NE
M-1

February 1, 1939

Stand Improvement in the Spruce Region

1. Field Division: Forest Management.

2. Work Project: Silviculture.

3. Line Project: Stand improvement in spruce types.

4. Purpose of Work: To develop measures for increasing the production and growth rate of spruce and fir, and improving the quality of growth.

5. Review of Past Work: Girdling of defective overtopping hardwoods has been shown to be an economical and effective method of increasing the growth rate of spruce, and has been widely adopted as a measure of stand improvement. Thinning of old-field spruce stands has also been shown to be a practical measure for increasing annual increment. Experiments in weeding of young spruce stands on cut-over areas and of thinning at later stages are under way. Selective pruning of crop trees to improve the quality of sawtimber yield is also in progress. Elimination of undesirable tree growth from planting sites, plantations, and stands of natural reproduction by poisoning and girdling has been studied. Poisoning, while killing the trees, often fails to prevent subsequent sprouting or root suckering. With aspen girdling without notching is most effective in eliminating root suckers.

6. Accomplishments during Past Year: None of the spruce thinning experiments escaped serious damage in the 1938 hurricane. Girdling plots were damaged to a lesser degree, and weeding plots escaped with practically no damage. In the thinning experiment at the Gale River Experimental Forest established in 1933, remeasurement just prior to the hurricane showed that greatest wood volume, 73.4 cubic feet per acre per year, was produced on the lightly thinned plot with the largest growing stock, but the greatest volume growth percentage occurred on the heavily thinned plot which had the smallest growing stock. Evidently the heavy thinning induced greatest stimulation in growth on the residual trees.

7. Plans for Next Year: All plots affected by the hurricane will be worked over during 1939, restoring as many as possible to useful condition and preparing progress reports wherever radical changes have occurred. A new thinning experiment, following in principle at least the work destroyed at Gale River, will be established if a suitable location can be found. Also studies in weeding, girdling, and releasing will be continued.

8. Date of Completion: A continuing project based largely on permanent sample plots. Progress reports will be prepared from time to time.

9. Assignment: M. Westveld.

RS - NE
M-4

February 1, 1939

Stand Improvement in Northern Hardwoods

1. Field Division: Forest Management.

2. Work Project: Silviculture.

3. Line Project: Stand Improvement in Northern Hardwoods.

4. Purpose of Work: To determine the effects and feasibility of thinnings, weedings, and mowings in the development of northern hardwood stands.

5. Review of Past Work: In a thinning experiment initiated in 1932 involving instrumental records of changes in environmental conditions, some of the yellow birch showed signs of decadence after the second growing season but otherwise appeared thrifty and were making satisfactory development. On the basis of 5-year records, the residual stand as a whole increased in volume about 4 percent annually; even yellow birch in spite of losses from exposure showed an increase in net volume three times as great on the thinned as compared with the check area. Evaporation and wind movement at first increased more than 50 percent as a result of the heavy thinning but again approached normal as the stand closed.

Other plots afford comparison of different degrees of thinning in even-aged 40- and 60-year stands.

Weeding experiments involving twenty-one intensive plots indicate that where a sufficient number of potential crop trees are present to justify weeding, best results are obtained if stands are treated before they are 10 years old.

On recently clear-cut areas mowing, or cutting back of all advance reproduction, is being tried as a means of improving form and stimulating growth of the new stand. Better results are obtained at lower cost when mowing is done prior to cutting of the original stand. Studies have also been made on relative merits and comparative costs of transporting cordwood from stand improvement cuttings to truck roads by means of portable steel chutes and using horses. Under certain conditions economies in operation can be effected by use of the portable steel chute.

6. Accomplishments during Past Year: The periodic remeasurement of the weeding plots indicated that cutting should be restricted to the removal of stems overtopping the crop trees as the benefits of additional work were negligible; in fact, might actually be a liability in regions of heavy snowfall.

Moderate thinnings in a 60-year-old stand provided conditions extremely favorable to the establishment of white ash reproduction. The value of mowing work carried on during 1938 will be largely lost because, as a result of the hurricane, the overstory will not be removed as contemplated.

7. Plans for Next Year: Following a clean-up and reinventory of the intensive work areas damaged by the hurricane, portions of the plots will be eliminated. The first of a series of weeding operations will be initiated on clear-cuttings made in and subsequent to 1933.

8. Date of Completion: The value of weeding treatments should be demonstrated within a period of ten years. Mowing experiments will be terminated about 1943. In the thinning experiments records of growth must be started over again as a result of the hurricane. These and other cultural work are indefinite in duration.

9. Assignment: Victor S. Jensen.

RS - NE
M-3

February 1, 1939

Stand Improvement in White Pine

1. Field Division: Forest Management Research.

2. Work Project: Silviculture.

3. Line Project: Stand Improvement:White Pine Types.

4. Purpose of Work: To develop measures for increasing the production and growth rate of white pine and to improve the quality of growth.

5. Review of Past Work: Thinning and weeding experiments were initiated by the Forest Service as early as 1906, and additional work on established plots was undertaken in 1930. In 1937 silvicultural treatment to develop resistance to gypsy moth was started on the Massabesic Experimental Forest.

6. Accomplishments during the Past Year: The hurricane of 1938 damaged all of the older white pine plots, but did not affect work on the Massabesic Experimental Forest.

   Additional gipsy moth control experiments were indicated in a 50-year-old stand of red oak and white oak with an understory of white pine. The preponderance of oak made it impossible to reduce the proportion of favored food foliage to the desired amount in the initial operation. The Forest Insect Laboratory is cooperating in obtaining egg cluster and larval counts. On the area treated in 1937, long-suppressed white pine reproduction has suffered from sunscald when fully released.

   Studies of the use of a tractor for yarding cordwood from improvement cuttings were initiated. These include time requirements, damage to residual stand, and adaptability of scoots.

7. Plans for Next Year:

   a. Restoration, reorientation or closing-out of all hurricane-damaged plots with appropriate reports.

   b. Continuation of stand improvement work on the Massabesic Experimental Forest and completion of tractor yarding study.

   c. Initiation of studies of degree and time of pruning upon the growth of white pine.

8. Date of Completion: A continuing project. Hurricane damage reports will be completed during Fiscal Year 1940.

9. Assignment: H. F. Morey.

RS - NE
Pi-1

February 1, 1939

Silvicultural Control of Gypsy Moth

1. Field Division: Forest Management.

2. Work Project: Silviculture.

3. Line Project: Stand Improvement:Silvicultural control of gypsy moth.

4. Purpose of Work: To work out silvicultural practices reducing the proportion of species favored by the gypsy moth and to determine the extent to which existing forests in the infested area lend themselves to such treatment.

5. Review of Past Work: Work undertaken in 1936 in cooperation with the office of Gypsy Moth Control, Bureau of Entomology and Plant Quarantine, largely to provide technical background for Civilian Conservation Corps control operations. The extent to which Massachusetts forests lend themselves to silvicultural control was analyzed on the basis of state forest survey data. Experimental treatments have been established for future observation.

6. Accomplishments during 1938: No action except to present results and suggestions in public addresses.

7. Plans for Next Year: Article on "Opportunity for Silvicultural Control of Gypsy Moth in Massachusetts Woodlands," prepared early in 1939 for publication in Journal of Forestry.

8. Date of Completion: 1939. Experimental areas to be assigned to "Timber Stand Improvement--white pine types" for follow-up.

9. Assignment: C. Edward Behre.

RS - NE
M-1

February 1, 1939

Slash Studies in the Spruce Region

1. Field Division: Forest Management.

2. Work Project: Silviculture.

3. Line Project: Silvics: Ecology of Slash in Spruce Types.

4. Purpose of Work: To determine the effect of slash on reproduction and the rate of slash decay and its relationship to the protection of forests from fire.

5. Review of Past Work: Studies show that dense softwood slash not only kills advance reproduction beneath it but effectually prevents the establishment of new reproduction for a period of fifteen to twenty years. Hardwood slash rarely hinders reproduction seriously for more than five or six years. The rate at which slash decomposes varies greatly with respect to species, as well as size of material. Beech, birch, and maple slash decomposes from two to three times as fast as spruce and fir.

6. Accomplishments during Past Year: The intensive study of slash areas on the White Mountain National Forest, begun in 1937 to determine the influence of decay on fire danger, was continued in 1938. Spruce slash persists as an abnormal fire hazard for an unexpectedly long period. From fifteen to twenty years or more must transpire before spruce slashings may be considered safe.

7. Plans for Next Year: In 1939 it is planned to check the findings in the field with fire experts, and it is hoped serious gaps in the data may be filled by additional slash examinations.

8. Date of Completion: Indefinite.

9. Assignment: P. Spaulding, J. R. Hansbrough, and M. Westveld.

RS - NE
Soil Fauna

February 1, 1939

Soil Fauna

1. Field Division: Forest Management.

2. Work Project: Silviculture.

3. Line Project: Silvics: Soil fauna.

4. Purpose of Work: To determine the function of the animal life of the forest soil and organic layers as it affects fertility and percolation, and to determine how it is affected by fire, cutting, and other silvicultural measures.

5. Review of Past Work: The fauna of the litter and humus in an undisturbed stand in the red spruce-yellow birch type has been obtained. The animals eating out spruce leaves have been determined and a report prepared. The animals of the humus layer are being determined.

6. Accomplishments during Past Year: A new sampler has been constructed which will obviate rushing samples to the laboratory the day collected. It has been determined that microarthropods alone can not prevent spruce humus accumulation, and that millipedes and earthworms are probably an essential element of the reducing fauna. It was found that earthworms in limestone soils will maintain mull soil under spruce. In view of this discovery some of the proposed investigations on the humus microarthropods will be discontinued as not being of cardinal importance.

7. Plans for Next Year: Continue analysis of samples taken to determine effect of moss and slash on the fauna. Study earthworm and millipede populations of spruce stands growing on limestone soils to determine: (a) characteristics of castings of the different species, thus eliminating necessity of exhuming the earthworms to identify them; (b) season of activity of the different species of earthworms; (c) millipede activities on earthworm sites; (d) other possible faunal elements not present in the raw humus accumulations.

8. Date of Completion: A continuing project.

9. Assignment: Arthur P. Jacot.

RS - NE
B-Phenology

February 1, 1939

Phenology

1. Field Division: Forest Management.

2. Work Project: Silviculture.

3. Line Project: Silvics: Phenological observations on forest vegetation in the Northeast.

4. Purpose: To obtain observations on the leafing, flowering, and fruiting habits of forest trees, shrubs, and herbaceous vegetation throughout the region, and to correlate such observations with climatic conditions and other natural phenomena such as forest fires, rise and fall of insect activities, increase or decimation of wildlife populations, fruiting and spread of fungi, et cetera.

5. Review of Past Work:

(a) Since 1930, when this project was initiated, forty individuals and institutions and sixty Civilian Conservation Corps camps have taken observations of the leafing, flowering, and fruiting of selected forest vegetation.

(b) Fairly complete meteorological records are being obtained at the Gale River and Bartlett Experimental Forests and the Cherry Mountain experimental area on the White Mountain National Forest; the Hopkins Memorial Experimental Forest at Williamstown, Massachusetts; the Chenango Experimental Forest at Norwich, New York; and the Massabesic Experimental Forest at Alfred, Maine.

6. Accomplishments during Past Year: In addition to the regular seasonal observations, the fourth annual report on prospective crops of various forest trees was issued early in the fall, based on questionnaires sent to all cooperative observers. Miscellaneous observations on the effects of the 1938 hurricane and relative windfirmness of various species were compiled.

7. Plans for Next Year: Cooperation will be solicited as usual. The experimental forests maintained by the station will furnish phenological and meteorological records as in the past. Region-wide data on periodicity of seed years of important forest trees and upon effects of unusual climatic factors, such as ice storms, severe winters, drought, et cetera, will be compiled. In connection with the genetics project data on flowering habits are being obtained.

8. Date of Completion: Termination of cooperative observations tentatively set for 1940.

9. Assignment: P. W. Stickel.

RS - NE
ME-3

February 1, 1939

Volume Tables for Northern Hardwoods

1. Field Division: Forest Management.

2. Work Project: Mensuration.

3. Line Project: Tree studies -- volume tables for northern hardwoods.

4. Purpose of Work: To prepare regionally-applicable volume tables for the important northern hardwood species in terms of customary units of measurement.

5. Review of Past Work: Tables have been prepared for white ash, sugar maple, paper birch, yellow birch, beech, giving merchantable volume in cubic feet, in board feet by Scribner rule, and in board feet by International 1/4-inch kerf rule, by diameter and merchantable length. Tables for total volume in cubic feet of stem and branches have been prepared for the same species and for red maple. Complete measurements have been made of 308 trees for cordwood volume table purposes, and 77.5 cords of hardwoods have been piled repeatedly in various forms to study variations in piling, effect of species, and tree size on solid contents of stacked wood, and effect of bucking into shorter lengths on solid contents. Data have been assembled showing additional volume available with decrease of utilization limits from six to four inches, for correction of tables based on a 6-inch top diameter.

6. Accomplishments during Past Year: No additional material became available for incorporation in tables.

7. Plans for Next Year: Additional checks on the merchantable volume tables will be sought and any desirable corrections incorporated in the tables. Cordwood tables will be extended to include larger diameter classes as data become available.

8. Date of Completion: 1940.

9. Assignment: L. H. Reineke.

RS - NE
ME-2

February 1, 1939

Growth and Yield of Spruce and Fir

1. Field Division: Forest Management.

2. Work Project: Mensuration.

3. Line Project: Stand study--spruce and fir growth and yield.

4. Purpose of Work: To prepare normal yield tables for even-aged second-growth stands of red spruce, pure and in mixture with balsam fir, to determine the approach to normality of understocked stands; to provide a basis for prediction of growth of spruce and fir on cut-over lands; and to prepare tables of growth which will be applicable over the whole spruce region of the Northeast.

5. Review of Past Work: U. S. D. A. Bulletin 142 was published in 1929, giving tables of yield for fully stocked, even-aged, second-growth stands of spruce and fir. Twenty-one sample plots are being maintained in New Hampshire and Vermont to check these tables and to provide information on mortality, changes in composition, and the rate at which understocked stands approach normality. A special analysis of growth in northern Vermont and New Hampshire was made in 1936 for the Coos-Essex cooperative sustained-yield project. Data from some 400 plots on cut-over lands have been analyzed statistically to derive a mathematical expression of the volume of spruce and fir on cut-over lands, as a function of time since cutting, density (as indicated by the relation between number of trees and their average diameter) and composition (as indicated by proportion of the total basal area represented by spruce and fir).

6. Accomplishments during Past Year: The hurricane of September 21 caused considerable damage to four of the permanent plots in second-growth stands in which development and approach to normality were being followed. Fortunately, these plots had been given their scheduled periodic remeasurement only a few weeks before the hurricane.

7. Plans for Next Year: Establish additional plots in understocked stands as opportunity presents. Relocate, if possible, the temporary plots measured for the normal yield tables, and remeasure for check on tables. Complete report on growth on cut-over lands. Prepare report on regional growth analysis.

8. Date of Completion: Indefinite.

9. Assignments: L. H. Reineke and M. Westveld.

RS - NE
ME-3

February 1, 1939

Growth and Yield of Northern Hardwoods

1. Financial Project: Forest Management.

2. Work Project: Mensuration.

3. Line Project: Stand studies, composition, growth, mortality, and yield of northern hardwoods.

4. Purpose of Work: To provide the factual information required as to kinds, sizes, and quantities of forest products which will be produced within a given period of time so that forest management can be directed toward maximum value return under sustained yield handling of northern hardwood stands.

5. Review of Past Work: For study of yield in even-aged, second-growth stands of northern hardwoods, 52 permanent, intensive plots, and 114 extensive plots of which half are semi-permanent, have been established in Maine, New Hampshire, Vermont, and New York. The majority of these have had one remeasurement. The intensive plot measurements include data on form, defect, and merchantability, in addition to the usual stand measurements. Records covering thirty years on a number of sample plots are available for analysis of growth and yield. For growth prediction, the basic data of the 1932 survey of the Bartlett Experimental Forest is supplemented by some 5,000 cores from 128 plots measured for the Coos-Essex and Tioga cooperative projects. A special study of mortality on a large number of plots established in 1932 provided data never before available for growth predictions in northern hardwood types. Hardwood growth measurement was simplified by the design of an increment core-examining device, in which the cores are held and shaved off on both sides, giving a thin section readily transmitting light and thus rendering the growth rings quite distinct. No dyes or stains are needed, and the device can be used in the field as readily as the increment borer itself.

6. Accomplishments during Past Year: Four intensive permanent plots were completly destroyed by the hurricane of September 21 and five others were damaged appreciably, requiring modifications of objectives for those plots. Mortality and growth data were analyzed and assembled for growth predictions. A system of following mortality of trees and their disintegration was inaugurated for permanent sample plots. A special analysis of growth was made for the Tioga County survey project of Region 7, in New York.

7. Plans for Next Year: Continue maintenance of plots for study of yield of even-aged stands of northern hardwoods, which will give one remeasurement for all plots, and prepare tables of yield. Make clean-up of plots in which hurricane damage was not sufficient to necessitate abandonment. Preparation of report on standards for growth predictions in the spruce and northern hardwood region.

8. Date of Completion: Regional Growth Report and Yield Tables, 1940. Yield study plots to be continued.

9. Assignment: L. H. Reineke.

RS - NE
F-1

February 1, 1939

Planting

1. Field Division: Forest Management.

2. Work Project: Regeneration.

3. Line Project: Planting.

4. Purpose of Work: To determine most desirable types of plantings and to devise techniques that will improve plantation survival and growth.

5. Review of Past Work: Regional survey of plantations conducted in 1931 and 1932. Study of relation of method and depth of planting to survival and growth initiated in 1932. Plantings of mixtures of conifers and hardwoods in strips begun in 1933, and tests of groupwise arrangements begun in 1935. Poisoning of undesirable tree growth tested. Floristic study of wet areas carried on in 1935 with field tests of species and stock for planting in such areas. Nursery tests on density of sowing of coniferous seed were begun in 1936.

6. Accomplishments during Past Year: Two statistically-designed experiments in the establishment of dormant and rooted cuttings of hybrid poplars, including 4 clones, 6 methods of soil treatment, and 22,900 individual cuttings were established.

7. Plans for Next Year: Planting of mixtures and routine observations on established plantings will be continued. Stock from density of seedbed sowing experiment will be field tested. Studies in direct seeding of hardwoods will be initiated.

8. Date of Completion: Indefinite.

9. Assignment: L. H. Reineke.

RS - NE
Pf-1

February 1, 1939

Forest Fire Control

1. Field Division: Forest Management.

2. Work Project: Forest Fire Protection.

3. Line Project: Forest Fire Control.

4. Purpose: To assist administrative organizations in the fields of forest fire prevention, pre-suppression, and suppression by analyses of forest fire records and forest fire detection systems, by studies of rate of spread of fire and by testing the efficiency of new materials and equipment under actual burning conditions.

5. Review of Past Work: Analyses have been made of fire records of Vermont (1911-1926), Maine (1916-1925), New Hampshire (1921-1925), and Connecticut (1921-1925), and the results of these studies were turned over to the respective state forestry departments for administrative use and publication. Experiments were completed with calcium chloride and Zenith Fire Dust on grass fires, but neither material proved effective in retarding or extinguishing fires. Studies of the lookout detection system on the White Mountain National Forest and of the entire states of Rhode Island and Vermont were conducted in 1936 and 1937.

6. Accomplishments during the Past Year: Reports of the analyses of areas visible from potential lookout points on the White Mountain National Forest and in Vermont were completed and submitted to the administration agencies. The White Mountain National Forest detection study report is being used as the basis for replanning forest fire detection on that area.

   A series of control-burning plots totalling 40 acres were established during the spring fire season in white pine slash on the Quabbin Reservoir area in central Massachusetts for the purpose of securing data on the rate of spread of fire under different weather and fuel conditions. A ban on open fires was put into effect at the time when the plots should have been burned, and the difficulty of enlisting cooperation for work of this sort led to abandonment of the project.

7. Plans for Next Year: No new work is planned.

8. Date of Completion: Project closed out.

9. Assignment: P. W. Stickel.

RS - NE
Pf-2

February 1, 1939

Forest Fire Behavior

1. Field Division: Forest Management.

2. Work Project: Forest Fire Protection.

3. Line Project: Forest-fire behavior.

4. Purpose: To study weather and fuel moisture in relation to forest fuel inflammability in order to determine the various classes of forest fire danger that are the result of different types of forest-fire weather.

5. Review of Past Work: The results obtained from fire-weather studies conducted from 1926 to 1930 have been published as separate papers. The weather-fuel inflammability data have shown that duff moisture content is a reliable index to forest fire danger and that it can be estimated from integrated measurements of selected weather factors. Alinement charts for this purpose have been prepared for our important cover types in the Northeast. A general report on forest-fire danger in the region has been prepared. The material forming the basis of the previously issued alinement charts has been used in the preparation of fire-danger meters.

6. Accomplishments during the Past Year: A danger meter for the white pine type was published and given a fairly wide distribution. Similar meters for the mixed northern hardwoods and spruce-fir types were also prepared. The Station participated in the preparation of a general eastern danger meter that will be used by the special fire-weather service that has been established for the hurricane area. The Station was also instrumental in getting the Weather Bureau to reorient its fire-weather service in the region.

7. Plans for Next Year: If called upon, the Station will assist the special fire danger service that has been set up in the hurricane area. The general fire danger manuscript is being revised and will be submitted for publication during the early part of 1939.

8. Date of Completion: 1939.

9. Assignment: P. W. Stickel.

RS - NE
Pf-3

February 1, 1939

Forest Fire Effects

1. Field Division: Forest Management.

2. Work Project: Forest Fire Protection.

3. Line Project: Forest Fire Effects.

4. Purpose: To study the effect of forest fires upon standing timber, reproduction, and site as a basis for standardizing methods of appraising fire damage, and to furnish basic information pertinent to the reforestation and management of burned areas.

5. Review of Past Work: The effect of basal wounding by fire which is being studied on a series of plots mostly in the oak region has indicated that this class of injury is responsible for considerable delayed mortality and subsequently attack by decay-causing organisms. For the purpose of securing basic data for standard regional fire damage appraisal tables for the oak region, information has been secured from 425 temporary plots that were located in 24 fresh burns in Connecticut and New York. In order to give an insight into the differences in heat resistance between different trees, a laboratory study of the bark of six common northeastern species is under way. The evidence to date indicates that heat resistance of trees is associated with certain morphological and anatomical characteristics.

6. Accomplishments during the Past Year: The data secured from the cruise of a recently burned area were analyzed and summarized preparatory to publication. Equipment needed for completing the laboratory bark study was secured and a plan prepared for determining the lethal temperature of cambium tissue.

7. Plans for Next Year: The basal wound plots will be reexamined and a 5-year progress report will be completed. Regional damage appraisal table will be prepared and issued to interested agencies. Work on the laboratory bark study will be continued.

8. Date of Completion: The basal wound plots will be maintained for at least a second 5-year period, but annual examinations will no longer be necessary. The laboratory bark study will be completed in 1940.

9. Assignment: P. W. Stickel.

RS - NE
Genetics

February 1, 1939

Hybridization and Breeding of Forest Trees

1. Field Division: Forest Management.

2. Work Project: Forest Genetics.

3. Line Project: Breeding.

4. Purpose of Work: Controlled hybridization between and selective breeding within forest tree species for the production of improved types, and for information on inheritance and the mode of inheritance.

5. Review of Past Work: Hybridization and breeding during 1937 were more or less exploratory in nature. In addition to intraspecific progenies of known parentage, the following 1-year-old seedlings resulting from intraspecific pollinations are now growing in the nursery at the Hopkins Memorial Experimental Forest:

Acer	38	seedlings
Betula	799	"
Magnolia	127	"
Quercus	9	"

6. Accomplishments during Past Year: Breeding work was carried out with the following genera in 1938--Acer, Betula, Carpinus, Fagus, Quercus, Pinus, Hicoria, Magnolia, Tilia, Liriodendron, and Ostrya. Apparently successful hybridization was accomplished in all of the above genera except Fagus, Hicoria, and Magnolia.

   Studies on blooming habit made in connection with the breeding work indicate that dichogamy in many forest species such as maples, oaks, birches, and hickories makes self-pollination impossible. Hard maple exhibits reciprocal dichogamy; the individual trees fall in two groups, protandrous and protogynous which overlap in their period of bloom. Since the production of viable seed depends upon adequate pollination, studies on blooming habit, which involve the question of possible cross-pollinations between certain individuals and the inhibition of cross-pollination between other members of the same species, are of great importance to the solution of problems in natural regeneration.

7. Plans for Next Year: Breeding work will be continued with the genera mentioned above. It is possible to work all of these genera because they do not overlap in their blooming periods. Studies on blooming habit, flower behavior, and self- and cross-incompatibility will be carried on in connection with the breeding work.

8. Date of Completion: Controlled breeding will be continued every year.

9. Assignment: E. J. Schreiner and A. G. Snow, Jr.

RS - NE
Genetics

February 1, 1939

Vegetative Propagation of Forest Tree Species

1. Field Division: Forest Management.

2. Work Project: Forest Genetics.

3. Line Project: Propagation by cuttings.

4. Purpose of Work: To determine economically feasible methods for propagation of important forest tree species from cuttings.

5. Review of Past Work: During 1937 the rooting of dormant cuttings of aspen was increased to 65 percent by treatment with indolebutyric acid. Greenwood cuttings of white birch were rooted 50 percent; red maple, 60 percent; and yellow birch to a lesser extent.

6. Accomplishments during Past Year: Greenwood cuttings, treated with indolebutyric acid, were rooted in an outdoor sandbed--a practical method for the propagation of forest planting stock. Sugar maple cuttings rooted as high as 80 percent; red maple, 70 percent; and basswood, 25 percent.

7. Plans for Next Year: Experiments will be continued with dormant and greenwood cuttings of white pine, sugar maple, white birch, basswood, and red maple.

8. Date of Completion: Two to three years. It will be discontinued if some other organization undertakes adequate work along these lines.

9. Assignment: Albert G. Snow, Jr.

RS - NE
Genetics

February 1, 1939

Field Tests -- New Hybrid Poplars

1. Field Division: Forest Management.

2. Work Project: Forest Genetics.

3. Line Project: Segregation: Tests of Oxford hybrid poplars.

4. Purpose of Work: To determine the practical adaptability of the Oxford hybrid poplars in various parts of the United States.

5. Review of Past Work: Cutting stock for experimental distribution of the new hybrid poplar clones was produced at the nursery leased from the Oxford Paper Company during 1937.

6. Accomplishments during the Past Year: Fifty-eight selected hybrid clones were distributed to 26 cooperating Forest Service, Soil Conservation Service, and Bureau of Plant Industry nurseries throughout the United States. In addition, cuttings were also distributed to one State nursery and to several public and private organizations which had been cooperating with the Oxford Paper Company prior to 1938.

   The cooperation has been excellent, and data on the survival and growth of these hybrids during 1938 are available for analysis.

7. Plans for Next Year: Second-year nursery tests will be made at most of the cooperating nurseries, and field tests will be started in the various forest regions. It is not anticipated that any appreciable number of new cooperators will be asked to aid on this work. Analysis of the 1938 data on survival and growth at cooperating nurseries will be completed.

8. Date of Completion: Final results will be obtained from 10- to 15-year-old field plantations in various parts of the United States.

9. Assignment: E. J. Schreiner.

RS - NE
Genetics

February 1, 1939

Seed Source Investigations

1. Field Division: Forest Management.

2. Work Project: Forest Genetics.

3. Line Project: Segregation: Seed source investigations.

4. Purpose of Work: To select superior strains or varieties of native and exotic species specially adapted to conditions in the Northeastern region.

5. Review of Past Work: Scotch pine from seed collected at Boonville, New York, planted at widely scattered points in New England in 1932 and 1934. Fifth-year observations indicate that the Boonville Scotch pine will have a large percentage of crooked trees in most localities. Comparative plantings of two strains of Scotch pine, red pine, and white pine planted in 1924 at Mount Toby, Massachusetts.

6. Accomplishments during Past Year: Seed of red and white pine from Eagle Lake, Ontario, purchased and distributed to state nurseries for propagation and testing.

7. Plans for Next Year: Purchases of white pine seed from southern extremity of its commercial range, collection of white pine seed from western Maine, and distribution to state nurseries for propagation and testing.

8. Date of completion: Indefinite.

9. Assignment: E. J. Schreiner and L. H. Reineke.

RS - NE
Genetics

February 1, 1939

Inheritance of Sugar Content in the Sap of the Sugar Maple

1. Field Division: Forest Management.

2. Work Project: Forest Genetics.

3. Line Project: Segregation: Inheritance and mode of inheritance in forest trees.

4. Purpose of Work: To determine the possible inheritance and mode of inheritance of sugar content in the sap of sugar maple.

5. Review of past work: Preliminary experiments during 1937 indicated that there may be an inherent different in the sugar content of the sap of individual trees.

6. Accomplishments during Past Year: Tests for the percentage of sugar in sap were made on 98 trees tapped in the spring of 1938. Although no outstandingly high producers were located, inherent differences may exist which could not be detected by the crude methods used for the determination of percentage of sugar.

7. Plans for Next Year: A more refined technique for the determination of the percentage of sugar in maple sap will be used. If outstanding trees are found, they willbe used for selective breeding and will be vegetatively propagated as clones.

8. Date of Completion: Preliminary data within 2 to 3 years; final results when inheritance tests can be made on the progeny.

9. Assignment: E. J. Schreiner and A. G. Snow, Jr.

RS - NE
Genetics

February 1, 1939

Cytological Investigations

1. Field Division: Forest Management.

2. Work Project: Forest Genetics.

3. Line Project: Segregation: Cytogenetical Investigations.

4. Purpose of Work: Cytogenetical investigations fundamental to the understanding of inheritance in forest trees.

5. Review of Past Work: A series of problems were initiated on chromosome studies and pollen tube penetration technique with forest tree species in 1937. Readjustment of budget, resulting in a reduction of the genetics staff, made it necessary to discontinue this research.

6. Accomplishments during Past Year: Nothing was done on this line of investigation during 1938.

7. Plans for Next Year: It will not be feasible to employ a cytologist this year. Further work will therefore have to be deferred until 1940.

8. Date of Completion: Many phases can be completed within two or three years.

9. Assignment: No regular member of the staff now available.

RE - NE
Production Costs

February 1, 1939

Selective Logging

1. Field Division: Forest Products.

2. Work Project: Timber harvesting and conversion.

3. Line Project: Conversion: Logging and milling (a) northern white pine, (b) northern hardwoods, and (c) spruce and fir pulpwood.

4. Purpose of Work: To study the effect of different cutting practices upon operating costs and profits, with especial reference to size of timber, and upon ultimate silvicultural conditions.

5. Review of Past Work: The three phases of this project were carried out independently and aside from having common objectives might well be considered as separate projects. The pine and hardwood phases were initiated in 1934 and 1935 in cooperation with the Forest Products Laboratory. The Laboratory did not participate in the pulpwood study that was undertaken in 1935 as an ERA project. All three phases of this project brought out the economy in handling trees in the larger size classes. The spread between operating costs and sale values was more pronounced in pine and hardwood lumber operations than for spruce and fir pulpwood. The value of the pulpwood product does not vary with size, whereas in the case of lumber differences in cost of operation are augmented by increased values for the better grades produced from the larger trees. Comparative costs obtained on representative operations indicated that, except in the case of the smaller spruce and fir, partial cuttings added little or nothing to the handling charges for trees of a given size as compared with clear-cutting operations. This fact is highly significant as excessive operating costs are frequently advanced by operators as the sole justification for the usual indiscriminate clear-cutting practice, the other advantages of selective cutting being recognized and appreciated.

6. Accomplishments during Past Year: The preparation of a report, "The Costs of Producing White Pine Lumber in New England," was the major accomplishment on this project. The compilation and analysis of the pulpwood data were also completed. Field work on the areas cut over in connection with this project was restricted to observations on conditions after the hurricane. The work on pine and hardwood log grades had an unforeseen utility following the September hurricane as the basis for the log grades adopted by the Timber Salvage Administration and in providing authoritative data on operating costs.

7. Plans for Next Year: The 1938 hurricane will necessitate certain changes in the normal field program. Three of the six white pine, and one of the three hardwood study areas, have little or no future value for this project and will be abandoned after making a final detailed reexamination. The necessary maintenance work and periodic remeasurements will be obtained on the three remaining white pine areas. Based on the white pine study, a "Miscellaneous Paper" will be prepared on the manufacturing costs and values, while a "Technical Note" will cover the relative merits of edging the same species. A report will be prepared covering the production cost phases of the pulpwood study.

8. Date of Completion: This project will be completed in 1939 except for the periodic remeasurement of the methods of cutting plots that were established to follow the development of the cut-over areas.

9. Assignment: Victor S. Jensen.

RE - NE
Forest Survey

February 1, 1939

Forest Survey

1. Financial Project: Forest Survey.

2. Work Project: Survey of Forest Resources.

3. Line Project: Inventory: Cooperative technical supervision of an inventory of forest resources in southwestern Maine.

4. Purpose of Work: To insure adequacy of field methods in the CCC type map and inventory of the white pine region of southwestern Maine and to determine the most desirable technic for inventorying the entire Northeast.

5. Review of Past Work: In 1936 twelve enrollees and a foreman at each of four CCC camps in southwestern Maine began a type map and inventory of forest resources in accordance with plans for field and office work prepared by the Northeastern Station. Initial training of field crews was supervised by the Station. One CCC camp was discontinued in 1937, but the crews in the remaining three were doubled. Forty-five towns, about 900,000 acres, were covered by the 0.25 percent cruise in 1936 and 1937.

6. Accomplishments during Past Year: The survey was continued during the summer only, operating from two side camps. The crew of one CCC camp was transferred to spruce sawfly control. Seventeen towns were covered, bringing the total coverage to 62 towns (about 1,240,000 acres).

7. Plans for Next Year: Survey to be continued during spring, summer, and fall, operating from side camps to reduce travel. Technical supervision by the station to be continued.

8. Date of Completion: 1939 (if full quota of crews is available).

9. Assignments: L. H. Reineke.

RE - NE
Private Forestry

February 1, 1939

Cooperative Management and Marketing for Farm Woodlands

1. Field Division: Forest Economics.

2. Work Project: Private Forestry.

3. Line Project: Cooperative management and marketing for farm woodlands.

4. Purpose of Work: To establish the technical basis for cooperative management and utilization of farm woodlands in order to rebuild depleted growing stocks, restore and stabilize local forest industries, and afford woodland owners regular and more adequate income.

5. Review of Past Work: In late 1935, the Otsego Forest Products Cooperative Association was incorporated. It now has a membership of over three hundred. The principles upon which this Association is based, the form of organization, and the program of activity were adopted as a result of investigations and recommendations of the project staff. These included studies of land use, general economic status of the locality, forest management, wood processing and marketing. A processing plant especially designed to handle local material efficiently is being erected; it will serve about three hundred members annually and afford an outlet for the products of sustained yield forestry operations conducted on their woodlots. Since the whole program of the Association is integrated with other agricultural pursuits, the most direct effect of the activities has been and will continue to be to furnish supplemental income to local farmers in a self-sustaining and non-competitive manner.

6. Accomplishments during the Past Year: Considerable direct aid has been given the Association on formulating and carrying out its program. Control of cutting has been established on 269 farms using the unique methods previously developed on this project. In cooperation with the Forest Products Laboratory, a system of raw material grading and pricing was worked out and tested by the operation of 85 woodlots, the products from which were processed on a temporary, small sawmill. A simple, yet thorough, set of books were developed to give accurate and complete costs at various strategic points in the operations which extend from stump to consumer. Processing plant plans were perfected. Due to legal and financial difficulties construction was halted early in the year and was not resumed until November. Since then excellent progress has been made. Studies of the economics of last season's activities indicate the potential benefits under full operation. During the year the Association secured a supplemental loan from the Farm Security Administration; this and the original loan totalling $159,000 were administered by the project staff.

7. Plans for Next Year: Administration of the Farm Security Administration loan. Continuation of growing stock control studies until the Association is under full operation, and until sounder economic basis for timber marking is established. Analysis of extraction and processing operations to determine costs and returns from cuttings and to develop more efficient techniques. Studies of methods of grading and pricing raw materials. Studies of processing problems, with especial reference to small dimension manufacture. Study of rural labor problems with view to training men in cooperative management and operation techniques. Continued study of the general business and operating problems facing this new enterprise.

8. Date of Completion: Indefinite.

9. Assignment: C. R. Lockard, M. B. Dickerman, D. E. Rulison.

RE - NE
Forest Insurance

February 1, 1939

Forest Insurance

1. Field Division: Economics.

2. Work Project: Forest Insurance.

3. Line Project: The basis for forest insurance in the Northeast.

4. Purpose of Work: Investigation and promotion of practical methods of insuring forest properties against fire and other hazards.

5. Review of Past Work: The study has so far been applied only to insurance against loss from fire. Study of the Pacific Coast territory has been completed and the report published. Investigative work has been completed in the Northeast. Some promotional work was done in the Pacific Coast Region in 1937.

6. Accomplishments during Past Year: Report for the Northeast completed and submitted for publication. Negotiations with the National Association of Insurance Executives did not result in positive action, due largely to unstable financial condition of lumber industry in the Pacific Northwest and conflagration hazard in that region. Consultation with executives and northeastern field agents of one large insurance company interested in starting forest insurance in this region was suspended after hurricane of September, 1938.

7. Plans for Next Year: Indefinite, because of adverse effect of hurricane and resignation of Mr. Shepard. Contacts with insurance people will be renewed after the spring fire season.

8. Date of Completion: Investigative work all completed.

9. Assignment:

RI - NE
Watersheds

February 1, 1939

Streamflow on Forested Watersheds

1. Field Division: Forest and Range Influences.

2. Work Project: Influence of natural vegetation on streamflow.

3. Line Project: Relation of forest cover to streamflow.

4. Purpose: To study the streamflow on small forested watersheds and the effect of changes in vegetative cover and land use practices.

5. Review of Past Work: A weir and stream-gauging station has been constructed on the Chenango Experimental Forest. A series of five weir installations is being made on the Hopkins Memorial Experimental Forest, two having been completed in 1937.

6. Accomplishments during the Past Year: The field installation at the Chenango Experimental Forest was completed and placed in operation. The final construction work on two of the remaining three uncompleted weirs was set back by the flux accompanying the September hurricane. Streamflow measurements were obtained at two installations on the Hopkins Experimental Forest throughout the year. The hurricane storm of September, 1938, forced postponement of work on other weirs on this forest until 1939.

7. Plans for next year: The remaining weirs at the Hopkins Experimental Forest will be completed and steps will be taken to rate all of the installations at the two experimental forests. At the Chenango Experimental Forest a silting basin and a series of wells for obtaining data on ground-water depth will be constructed. The streamflow measurements will be continued.

8. Date of Completion: Indefinite; intensive work can not be undertaken until funds become available for the purpose.

9. Assignment: P. W. Stickel.

RI - NE
FCS
Surveys

February 1, 1939

Preliminary Flood Control Examinations

1. Field Division: Forest Influences.

2. Work Project: Flood Control Surveys.

3. Line Project: Preliminary Examinations.

4. Purpose of Work: In cooperation with the Soil Conservation Service and the Bureau of Agricultural Economics to make preliminary examinations of New York and New England watersheds enumerated in the Omnibus Flood Control Act of 1936 and subsequent Amendments thereto (1937, 1938) for the purpose of determining whether a detailed survey to develop a specific control program from the standpoint of run-off, waterflow retardation, and soil erosion prevention is justified.

5. Review of Past Work: Examinations of the Blackstone River (Rhode Island and Massachusetts) and Upper Susquehanna (New York) were completed and considerable work done on the Merrimac River (New Hampshire and Massachusetts).

6. Accomplishments during Past Year: Completion of reports for the Blackstone and Upper Susquehanna Rivers, conclusion being negative for the former and positive for the latter. Preliminary examination of the Merrimac was dropped in order to undertake detailed survey on that watershed. Late in the year, work was started on a preliminary examination of the Connecticut River.

7. Plans for Next Year: Complete Connecticut River report. Also reports for Wallkill and Cromline Creeks (New York), and the Winooski River (Vermont).

8. Date of Completion:

Connecticut River	-- April, 1939
Winooski River	-- July, 1939
Wallkill Creek	-- October, 1939
Cromline Creek	-- December, 1939

9. Assignment: Arthur Bevan, William Mollenhauer, and Earl J. Rogers.

RI - NE
FCS

February 1, 1939

Flood Control Surveys

1. Field Division: Forest Influences.

2. Work Project: Flood Control Surveys.

3. Line Project: Watershed Surveys.

4. Purpose of Work: Detailed surveys, in cooperation with Soil Conservation Service and Bureau of Agricultural Economics, of watersheds approved by the Secretary of Agriculture under the Omnibus Flood Control Act of 1936 as amended, to develop specific economically justified programs of headwaters flood control from the standpoint of land management retardation of run-off and soil erosion prevention.

5. Review of Past Work: Survey initiated in 1938.

6. Accomplishment during Past Year: Initiation of work on Merrimack watershed under supervision of the Northeastern Station, and on Buffalo Creek (New York) under Soil Conservation Service leadership.

7. Plans for Next Year: Completion of Merrimack and Buffalo Creek Surveys; initiation of surveys on Connecticut River (New Hampshire, Vermont, Massachusetts, and Connecticut) by crew now engaged on Merrimack. Transfer of Buffalo Creek crew to Allegheny territory (Codorus Creek, Pennsylvania); initiation of survey on Upper Susquehanna by Soil Conservation Service.

8. Date of Completion:

Buffalo Creek	-- March, 1939
Merrimack River	-- June, 1939
Connecticut River	-- June, 1940
Upper Susquehanna	-- June, 1940

9. Assignment: Field Working Committee: Arthur Bevan and William Mollenhauer.

Merrimack Survey
K. L. Roberts
W. K. Starr
M. B. Bruce

Buffalo Creek Survey
C. H. Stoddard, Jr.
Sidney Grossman

PERSONNEL

Northeastern Forest Experiment Station

February 1, 1939

Name	Grade	Title
ADMINISTRATION		
C. Edward Behre	P-6	Director
Mary E. Turrell	CAF-6	Principal Clerk
Esther S. Moos	CAF-4	Clerk-Stenographer
Julia J. Braun	CAF-3	Assistant Clerk-Stenographer
Katherine A. Fitzgerald	CAF-3	Assistant Clerk
Marian M. Thomas	CAF-3	Assistant Clerk-Stenographer
Lillian M. Antell	CAF-2	Junior Stenographer
Ruth Bick	CAF-3	Assistant Clerk
FOREST MANAGEMENT		
Silviculture		
M. Westveld	P-5	Senior Silviculturist
V. S. Jensen	P-3	Associate Silviculturist
A. P. Jacot	P-3	Associate Conservationist
H. F. Morey	P-2	Assistant Silviculturist
Halsey M. Hicks (9 mos.)	P-1	Junior Forester
Basil A. Plusnin	P-1	Junior Forester
Konstantin T. Belotelkin	P-1	Junior Forester (CCC)
Arthur C. Hart	P-1	Junior Forester (CCC)
Raymond Ellstrom	P-1	Junior Forester
Dana F. Bissell	SP-4	Assistant Field Assistant
Robert E. Edwards	SP-1	Minor Field Assistant
Mary C. Weldon (8 mos.)	CAF-5	Senior Clerk
Alice K. Swain (6 mos.)	CAF-3	Assistant Clerk
Carlisle R. Saxton	SP-4	Asst. Engineering Draftsman(Mech.)
Mensuration and Regeneration		
L. H. Reineke	P-4	Silviculturist
Frank E. Cunningham	P-1	Technician - Forestry
Mary C. Weldon (4 mos.)	CAF-5	Senior Clerk
Alice K. Swain (4 mos.)	CAF-3	Assistant Clerk
Forest Fire Protection		
P. W. Stickel	P-4	Silviculturist
Alice K. Swain (2 mos.)	CAF-3	Assistant Clerk
Grace Moskowitz (3 mos.)	CAF-3	Assistant Clerk
Forest Genetics		
E. J. Schreiner	P-4	Silviculturist
A. G. Snow, Jr.	P-1	Junior Plant Physiologist
Halsey M. Hicks (3 mos.)	P-1	Junior Forester
Stephen Lawler	SP-4	Assistant Field Assistant
Harold F. Ford	SP-3	Junior Assistant to Technician
Grace Moskowitz (9 mos.)	CAF-3	Assistant Clerk

Name	Grade	Title
FOREST ECONOMICS		
C. R. Lockard	P-4	Forest Economist
M. B. Dickerman	P-1	Junior Forester
Donald E. Rulison	P-1	Junior Forester
Harry B. Price	CAF-2	Junior Clerk-Stenographer
FLOOD CONTROL SURVEYS		
General Supervision and Preliminary Examinations		
Arthur Bevan (half time)	P-5	Senior Agricultural Economist
Benton MacKaye	P-4	Conservationist
William Mollenhauer (half time)	P-2	Assistant Conservationist
Earl J. Rogers	SP-6	Senior Field Assistant
Helen Wienhusen	CAF-3	Assistant Clerk-Stenographer
Merrimack River Survey		
K. L. Roberts	P-3	Associate Conservationist
W. K. Starr	P-2	Assistant Conservationist
M. B. Bruce	SP-8	District Forest Ranger (Cl.1)
Catherine Heaphy	CAF-4	Clerk-Stenographer
Robert A. Dubois	SP-4	Asst. Field Assistant(Drafting)
Bertram Goodell	SP-4	Assistant Field Assistant
John A. Downs	SP-4	Assistant Field Assistant
Herbert P. Orland	SP-4	Assistant Field Assistant
Ernest E. Thompson	SP-2	Under Field Assistant
Clyde F. Peick	SP-2	Under Field Assistant
George H. Aurelio	SP-2	Under Field Assistant
H. Roger Slayback	SP-2	Under Field Assistant
Almon D. Quick	SP-2	Under Field Assistant
Roscoe N. Knight	SP-1	Minor Field Assistant
Buffalo Creek Survey		
C. H. Stoddard, Jr.	P-2	Assistant Forest Economist
Sidney Grossman	SP-6	Senior Field Assistant

Publications Issued during 1938

Afanasiev, Michel. Effect of Indolebutyric Acid on Rooting of Greenwood Cuttings of Some Deciduous Forest Trees. Jour. Forestry, 37(1):37-41. January, 1939.

Jacot, A. P. Some New Western North Carolina Moss-Mites, Proc. Ent. Soc. Wash., 40:10-15. January, 1938.

_____ A Pseudogarypin Pseudoscorpion in the White Mountains, Occ. Papers, Boston Soc. Nat. Hist., 8:301-303, 4 text figs. March, 1938.

_____ New Moss-Mites, Chiefly Midwestern-III, Am. Midl. Nat., 19:647-657, pls. 1-3. May, 1938.

_____ More Primitive Moss-Mites of North Carolina-III, Jour. Elisha Mitchell Sci. Soc., 54:127-137, pls. 12, 13. June, 1938.

_____ More Box-Mites of the Northeastern United States, Jour. N. Y. Ent. Soc., 46:109-145, pls. 9-11. June, 1938.

_____ Authority Citations in Biological Nomenclature, Science, 88:240. September, 1938.

_____ Thomas Say's Free-Living Mites Rediscovered, Psyche, 45:121-132, pl. 14. September, 1938.

_____ Four New Arthropods from New England, Am. Midl. Nat., 20:571-574, 3 figs. November, 1938.

_____ The Geenton Mites of Florida, Fla. Ent., 21:49-57, 4 figs. December, 1938.

Schreiner, E. J. Breeding of Forest Trees in the Northeastern Region for Timber and Crop. Rpt. Proc., Sixth Annual Meeting, Pennsylvania Nut Growers Association, Harrisburg, Pennsylvania, January 20, 1938.

_____ Creative Forestry. The Paper Industry and Paper World, pp. 302-307. June, 1938.

_____ Forest Tree Breeding Technique. Jour. Forestry, 36(7):712-715. July, 1938.

Snow, A. G., Jr. Use of indolebutyric acid to stimulate the rooting of dormant aspen cuttings. Jour. Forestry 36(6): 582-587. June, 1938.

_____ Review of "Growth of Douglas Fir Trees of Known Seed Source" by Munger and Morris. Jour. Forestry 36(7):727-729. July, 1938.

Stickel, P. W. Review of "Forest Protection" by R. C. Hawley, John Wiley & Sons, 1937. Reviewed in Yale Forestry School News 26(1):9. 1938.

_____ Northeastern Forest Fire Danger Meter for White Pine Duff. Issued by Division of Forestry, Massachusetts Department of Conservation. 4 pp. April, 1938.

_____ Review of "Ecological Changes Due to Thinning Jack Pine" by T. S. Hanson, Tech. Bull. 124, Agric. Exp. Sta., Univ. Minn. Reviewed in Yale Forestry School News 26(3): 36-37. 1938.

_____ Northeastern Forest Fire Danger Meters. Northeastern For. Exp. Sta. Tech. Note 25. Mimeo. 4 pp. August, 1938.

_____ Review of "Forest Pathology" by J. S. Boyce, McGraw-Hill Book Co., 1938. Reviewed in Yale Forestry School News 26(4):53-54. 1938.

Westveld, M. Silvicultural Treatment of Spruce Stands in Northeastern United States. Jour. Forestry 36(10):944-950. October, 1938.